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SMALL USERS OF ELECTRICITY.

The increasing use of electric lights and power among small consumers is very noticeable, though when one stops to consider it is frequently in just such cases that the best results may be expected. A few years ago electric lights were generally looked upon as suitable for public buildings and other places where expense was not considered, but to-day the man who has use for but a few lamps is finding that the electric light is not only safer, but better and cheaper. One finds even the bootblack stalls with their complement of incandescent lamps and electric fans. The small shops are putting in incandescent lamps, and places of entertainment which a few years ago were unpretentious and illuminated by gas and oil are now brightly lighted with innumerable electric lamps. We may mention one such place in New York city, where there are moving pictures and other penny-in-the-slot shows, which has been converted into a dazzling palace by means of 2,500 incandescent lamps.

There is also a growing use of electric stoves and other devices of a similar character, which is not surprising if one remembers that, in addition to the convenience of an electric stove, it is economical, due to its method of use. It costs only one cent to run a chafing-dish or a tea-kettle for fifteen minutes. A broiler suitable for a family of five persons will broil a steak in about five minutes, at a cost of only about one and one-half cents. A heating-pad costs only three-quarters of a cent every hour of its use. Doubtless, if the cheapness of this elegant method of cooking and heating becomes more generally recognized, its use will increase more rapidly.

NEW POWER IN OLD LANDS.

Electrical methods are being adopted with surprising rapidity in certain of the Asiatic countries. One might expect the Japanese to turn quickly to this new power, but it was rather unexpected to find Japanese houses exhibiting well designed electrical apparatus at the World's Fair. Now India draws attention because the authorities there are beginning to realize how great the resources of that country are in the way of waterfalls, and how the various industries may be built up by means of the electric power and light. We noticed not long since the opening of an electrical railway in Mandalay. A still older story is the development of the Cauvery water power for use in the Kolar gold fields. Now we are told that the manufacturers of Bombay are investigating the available water powers within transmission distance of that city, and expect to develop these, using the power for lighting and for running their spinning and weaving mills. Another interesting scheme is now being studied and will probably be carried into effect, whereby a considerable fertile area will be recovered for cultivation. Lake Woolar, in Kashmir, has been the cause of much damage by flooding the lowlands near Srinagar, so that the farms lying along this stream have been abandoned. It is now suggested to develop the power of this river and to use it for irrigation, thus regulating the water supply and ensuring large yearly crops. At the same time power may be used to operate a river dredge, keeping a channel open and thus preventing these disastrous floods.

These are but a few of the projects, but they serve to indicate the great strides in electrical development that may be expected in that country during the next few years.

RATES FOR PUMPING CITY WATER.

Electric pumping of town and city water is on the increase, and this service constitutes a desirable load for public power stations. Two reasons combine to make the pumping of public water supplies a welcome addition to electric loads. One of these is the fact that the amount of work to be done in pumping water for a city or town is relatively large. Another reason lies in the nature of the pumping service, which can usually be done during those hours of the day when the demands of lighting and of other power loads are much below the maximum amounts.

The pumping of water supplies for the public requires rather large powers not only because of the great volumes of water to be moved, but also because of the considerable heads against which the water must usually be raised. An example of the capacities that pumping loads often involve may be found in a contract recently closed for the electric pumping of only a fraction of the water supply of a large city. In this case a motor of 1,500-horse-power capacity was direct-connected to a pump competent to deliver twenty-five million gallons of water daily when operated continuously during each twenty-four hours. This is only about one-fourth of the daily consumption of the city.

Nearly all well designed waterworks systems provide for storage, either in stand-pipes or reservoirs, and herein lies the especially desirable nature of the pumping loads for electric stations. As the water is first pumped into the stand-pipe or reservoir and flows thence through the mains to the service pipes of consumers, it is not usually necessary that the pumping be done at a uniform rate, or even that it be continuous. Where one or more stand-pipes furnish the only storage capacity, that capacity is apt to be relatively small, and the requirements as to the pumping load are more nearly uniform. If there is a fair amount of reservoir capacity, on the other hand, the pumping load may easily be varied to suit the other demands on an electric system.

Rates for pumping water are usually wanted in dollars and cents per thousand gallons, rather than in cents per horse-power or kilowatt-hour. In order to make such rates the efficiency of motors and pumps and the head against which the water is pumped must be taken into consideration, because all of these factors affect the power and energy required. If the resistance to the movement of the water is known in feet of head it is only necessary to multiply the number of feet by the weight of one thousand gallons to determine the foot-pounds of work that must be done on that quantity. When the resistance against which the pump must work is given in pounds per square inch this quantity may be reduced to feet of head by division by 0.43. One thousand gallons of cold water weighs about 8,350 pounds, so that the work done in raising it to a height of 100 feet, or against a head of 100 feet, amounts to 835,000 foot-pounds. The mechanical equivalent of one kilowatt-hour of electric energy is 2,654,200 foot-pounds, so that the work of raising 1,000 gallons of water 100 feet high is the equivalent of 0.314 kilowatt-hour. This makes a convenient unit for computations.

An electric motor of not less than fifty-horse-power capacity should have an efficiency of at least ninety per cent, and its direct-connected pump about seventy-five per cent at full load. These figures give a combined efficiency of $0.90 \times 0.75 = 0.675$, or sixty-seven per cent for the pump and motor. Units of several hundred horse-power will show slightly better results. In pumping operations, however, the motors will often have to work at between one-half and three-fourths load, and the average combined efficiency in regular service may well drop to sixty per cent. For such cases the motors must draw $0.314 \div 0.6 = 0.52$ kilowatt-hour from the electric line for each 1,000 gallons of water moved against a head of 100 feet. Owing to the rather large loads that pumping plants offer, and to the fact that their work may be done largely at times of day when other demands on the electric system are relatively small, power can often be had for this service at attractive rates. In a certain small city where the average daily consumption of water is about 100,000 gallons the local electric company contracted to supply power for pumping against a head of 250 feet for four cents per 1,000 gallons, some time since. On the basis of efficiency above considered the electric energy drawn from the supply system in this case must amount to $0.52 \times 2.5 = 1.30$ kilowatt-hours for each 1,000 gallons of water pumped, because the head is 2.5 times 100 feet. As the contract rate in this case was four cents per 1,000 gallons pumped, the energy charge per kilowatt-hour was about 3.08 cents. The electric system that supplied this energy was operated with soft coal costing about $2.50 per ton.

In another case the contract rate was 6.5 cents per 1,000 gallons of water pumped against a head of 116 pounds, which is the same as 270 feet nearly. The kilowatt-hours for this service is $0.52 \times 2.7 = 1.40$ per 1,000 gallons of water pumped, on the basis of an average efficiency of sixty per cent for the pumping equipment. Per kilowatt-hour the charge here amounts to $6.5 \div 1.4 = 4.64$ cents. As the electric energy in this case is developed by water power, and the pumping load is quite large, requiring motors of several hundred horse-power capacity, the rate named should show a good profit.

In contrast with the last-named case is another where electric energy developed by water power is sold for pumping water at the rate of thirty dollars per year for each horse-power of maximum load. This power may be used all day and every day of the year by the waterworks system at the rate named. It is probably impossible in this case to continue the pumping at maximum load for twenty-four hours per day and 365 days in the year, but the pumping work will, perhaps, amount to as much as 6,000 hours yearly at full load. On this basis the cost is only 0.5 cent per horse-power-hour.

The above illustrations are sufficient to show that wide differences exist in the rates charged for electric pumping of water supplies. Such conditions are probably due in part to the practice of local city officers in asking for rates per 1,000 gallons pumped, instead of for rates per kilowatt-hour. If the electric company takes all risk of loss in the pumping system it naturally asks a higher rate for the service.

ALTERNATING CURRENTS.

With profound satisfaction and unqualified approval do we observe the change that is manifesting itself in the methods of considering alternating-current phenomena.

Since the inception of the electrical art this particular branch has been held as marvelously intricate, to be approached only with reverence and awe, and its comprehension limited to such minds as were of almost superhuman sagacity. To write and hold forth on alternating currents was to drag the limelight of sublime profundity to focus on the gifted discusser, while a gaping world stood by and wondered, but never understood.

In reality the subject was always obscured by the clouds of hopelessly involved formulæ that were in most cases built up on natural mathematical expressons due to Maxwell and surreptitiously abstracted from his works to produce a glorious haze of mathematical splendor, and dazzle the exoteric. Mathematical fictions, which served the useful purpose of making calculations easier, and of allowing a better coordination of the various interdependent reactions to arrive at final results, were taught as being actual physical happenings. What wonder that the student emerged from the halls of learning with more bewilderment than knowledge? Happily a better day is now breaking. Recent writings are relieving this impossible situation. Some that have appeared in the last few months have set forth the physical facts as they really exist, and shown that an understanding of alternating-current phenomena is as simple as that of continuous currents if they be properly presented.

In the last issue of the *Stevens Indicator* there is an article by Mr. E. J. Willis, entitled "A Protest in Behalf of the Wattless Current." The only erroneous thing in this writing is its name. It should have been called "A Protest Against the Wattless Current," for that is what the subject really is.

Mr. Willis shows that volts multiplied by amperes is always equal to the watts, whether the circuit be inductive or not. It only requires that the readings of volts and amperes be made at the same time, which is the requirement for the actual computation of watts in a direct-current circuit; alternating currents change their values too rapidly to admit of such measurements. No instrument records anything except the $\sqrt{\text{mean}-2}$ value of volts or amperes, and multiplying those together in no wise means that the instantaneous values were the factors used. Furthermore, there is no "wattless" current. As a convenient way of computing various qualities the current may be separated into two parts—one in phase with the impressed electromotive force and called the energy current; the other part at ninety degrees to the impressed electromotive force and called the "wattless" current. The fact that the heating effect in any conductor is proportional to the square of the total, not the energy current, should have shown conclusively the absurdity of the "wattless current" idea.

When one reads of inductance acting like ohms—being called the equivalent of ohms in fact in some works; of the current being ahead of or behind the electromotive force which causes it to flow, that when a condensance or inductance is put in a current the current no longer flows in accordance with Ohm's law, and knows that such misleading statements form the substance of nearly all the teaching and books on the subject, we cry Oh! Lord, how long!

Inductance or condensance is an electromotive force with a time-phase, which differs from that of the impressed electromotive force. The resultant of the electromotive forces acting, *i. e.*, the impressed, the induction and condensance electromotive forces, produces a current flow in exact phase with this resultant electromotive force and which follows Ohm's law rigorously.

"There is no wattless current," so says Mr. Willis, and he is right. We can criticise only two features of his article, one is the caption, the other is that he didn't write it long ago.

INTERESTING RESULTS IN STEAM ENGINEERING.

At the recent meeting of the American Society of Mechanical Engineers several matters of interest to electrical engineers were brought up. Mr. George I. Rockwood, while discussing condensers for steam turbine plants, showed that a vacuum as high as twenty-nine inches was obtainable, but he said in his discussion that he had not found condensing plants in operation giving a vacuum as high as this. On the other hand they were down as low as twenty-six or even twenty-four inches. To obtain the higher figure the greatest care is necessary in erecting a condensing plant; and since the high efficiency of the steam turbine is only obtainable when high vacua are maintained, it is disappointing to learn that, in some cases at least, conditions are so unfavorable to the turbine. This matter should receive the immediate attention ot erecting and operating engineers—the one to see that the condensing plant is properly installed, and the other to see that it is properly maintained and operated.

Another point brought out at this meeting was the high efficiency obtainable under normal working conditions of a steam locomotive. It was shown by Mr. E. A. Hitchcock in this paper that the passenger locomotive tested developed one horse-power with about twenty-nine pounds of steam. The evaporation of the boiler was from nine to over ten pounds of water per pound of fuel, the former figure including the fuel used when standing. While this is the performance of a locomotive in regular service, it is not proof that all steam locomotives are giving such excellent results. Indeed, the opposite is probably the case. But the test does show what can be done with careful design and intelligent handling. Such being the condition of affairs an argument in favor of replacing steam by electricity on main lines will have to be based on some other reason than that of increasing the efficiency. The large generating station will, of course, give a better economy than this locomotive, but for operating under varying load and if all losses of transmission are considered there will be very little gain left to offset the enormous cost of the electrification.

Electrical Notes from India.

Tenders have been received for a proposed hydroelectric installation to be located near Lanauli, a health resort some fifty miles out from Bombay. The capacity of the proposed plant is 17,000 brake horse-power at the turbines, operating under a head of about 1,500 feet and transmitting by shortest route (forty-three miles) at such a generated voltage which, including all line losses, will afford a voltage of 13,000 for use in the numerous cotton mills located in Bombay.

The transmission line will be duplicate three-phase, using No. 00 B. & S. stranded copper supported on steel towers spaced some 160 feet apart. The selection of the shortest route for the line involves crossing a 6,000-foot stretch of the bay. Here the transmission wires will be sixty feet clear of high tides so as not to interfere with small shipping in the bay.

Engineers are at present prospecting upon the most suitable location for a huge masonry dam to be erected across the basin of the small mountain stream, having its source in the Western Ghants and flowing westward into the Indian ocean.

It is not necessary to enumerate the many advantages to be derived from induction motor drive in cotton mills where fire risks must be reduced to a minimum. The cotton mill owners of Bombay should consider themselves very fortunate, especially from a financial standpoint, should they secure the cheap power afforded through a successful culmination of the proposed hydroelectric scheme.

At present writing Mr. Harry P. Gibbs, chief electrical engineer to Mysore government, is in Bombay, on leave, looking into the details of the proposed scheme for which he is acting in the capacity of consulting engineer.

There has recently been completed, and is now in successful operation, a hydroelectric installation of approximately 1,000-horse-power turbine capacity, located in the Nilgira hills near the Katany river falls, in the Madras presidency. Four turbines of 230 horse-power each are direct-connected to 125-kilowatt, 5,000-volt, three-phase generators. There are four 110-volt exciters of twenty-five kilowatts each, direct-connected to turbines of thirty-seven-horse-power capacity each. The available head is 630 feet and length of pipe line some 2,250 feet with a gradient of forty-nine degrees for 445 feet from forebay, while the remainder of pipe line inclines at lesser angles. A large dam was constructed having a storage capacity of 7,000,000 cubic feet of water which affords approximately twenty days' supply.

The short length (three and one-half miles) of the transmission line does away with the use of step-up transformers. The power is used entirely by the Cordite factory, owned and controlled by the government of India. Here the voltage is stepped down to 380 for operating the induction motors which drive various machines throughout the factory.

All of the electrical equipment was supplied by the British Thomson-Houston Company, of Rugby, England, while the hydraulic equipment throughout was installed by the hydraulic engineering firm of W. Gunther & Sons, of Oldham, England.

Major A. J. de Totbinierre, deputy chief engineer to Mysore state government, has recently returned from the northern provinces of India where he was called to investigate several engineering projects among which is a pumping station for Simla, in which three electrically driven centrifugal pumps connected in series and having 500-foot lift each will probably be installed.

The most important of the northern projects is the probable installation of a 100-mile, single-phase electric railway in the agricultural district of Kashmir. Lake Woolar, near Srinagar, is the cause every year of serious floods which make most valuable agricultural lands untenable. Furthermore, the floods are proving to be more disastrous each year. The floods are due to the gradual silting of the river bed below the lake. By dredging and straightening the river channel, it is believed that the floods may be avoided. Thousands of acres of fertile land will thus be recovered, and by means of systematic irrigation will be made to yield agricultural products, the transportation of which will help to support the proposed electric railway through this district. An electric dredge will be employed to clear the river channel. Power for this purpose and also for the electric railway will be obtained from a hydroelectric installation located near the lake.

That engineers in India should be among the first to favor the adoption of single-phase motors for tractive power on a 100-mile railway is a criterion of what the future holds in store for electric railways for heavy as well as light traffic.

The Perujar scheme for the development of 30,000 horse-power in the province of Trevancore, southern India, has not as yet made much headway. It is probable, however, that the scheme will ultimately be carried out; as to how soon, it is not possible at present date to state.

A. C. H.

Sivasamudram, November 15.

The Barclay Printing Telegraph System.

For some years past Mr. John C. Barclay, assistant general manager of the Western Union Telegraph Company, has been at work developing a printing telegraph system in which the disadvantages of other systems might be eliminated. The apparatus is now in such shape that it is being used in regular service on the Western Union lines between Buffalo and New York. It is simple in operation; the sender manipulates a keyboard, and the movements of the keys send out over the line a certain number of electrical impulses which, when passed through the receiver, operate a printing mechanism similar to that used in the Blickensderfer typewriter. This is not a synchronous system, but the sending of the signals preserves the proper relation of a sending and receiving apparatus. The messages may be sent as rapidly as the operator can manipulate his keyboard, and, indeed, they can be sent at the rate of one hundred words per minute if the messages are first prepared by punching a strip, which is then passed through an automatic sender of the Buckingham type. At the receiving end the messages are printed in page form on ordinary telegraphic blanks, the latter being fed in to the receiver as they are needed.

Mr. Barclay's system was described in his paper before the recent International Electrical Congress, in a general way. At the present time the patent situation does not allow the instrument to be described in detail. Those which have already been put into use have given satisfactory service, and the number will be increased as rapidly as they can be constructed.

The National Electric Light Association.

At a meeting of the executive committee of the National Electric Light Association, held in New York, December 6, the dates fixed for the Denver-Colorado Springs convention were June 6, 7 and 8 at Denver, and June 9, 10 and 11 at Colorado Springs. Mr. Henry L. Doherty has already organized a local executive committee in Denver to take up arrangements for the convention with a number of special committees that are already at work.

The National Electric Light Association has issued a report on thawing water pipes by electricity. This report is compiled by Mr. George S. Haley, of Rutland, Vt., and comprises data received from seventy-five different companies which have already had experience in this direction.

GROUNDED TRANSMISSION MEDIUMS—IV.

BY J. STANLEY RICHMOND.

STRAY TRANSMISSION.

Electrolytically, the most important of the many phases of grounded return investigations is the securing of data relative to the amount of accidental transmission by means of auxiliary earthed conductors, such as water-pipes, gas-pipes and cable sheaths; to obtain which several methods have been adopted. These can be roughly summed up under four headings, as follows:

1. Amperes calculated from drops taken on two-foot lengths.

2. Amperes calculated from ampere and drop readings taken between distant points.

3. Amperes measured between the ends of a break in the accidental conductor.

4. Amperes taken experimentally in connection with plant laid especially for such purpose.

Of these four methods, the first is the most popular one; particularly with those corporations which are arranged on the opposite side to the traction interests. The apparatus required is a meter with fifteen and 150-millivolt ranges with its calibrated leads (preferably a duplex one, Richmond pattern; because such is useful in checking the Conant bond-tester used in another branch of the investigations); a medium-sized rough file; a two-foot rule; a cold chisel and a chipping (machinist's) hammer. To use the apparatus, excavations about four feet long and wide enough to allow ingress and egress to the reader are made at various points of such a depth as to completely uncover the pipe or other earthed conductor to be tested. In each hole excavated, the conductor is cleaned at two places about two feet apart by means of the chisel and hammer followed by the file. Points two feet apart are then accurately laid off on such cleaned surfaces with the rule and the drop taken between such with the meter. When all the drops are taken and by use of a prepared table of the resistances of two-foot lengths of different sized pipes or cable-sheaths, the C is calculated by $\frac{E}{R}$, where E = the reading obtained and R = the resistance of the two feet. This popular method, whereby the two feet of metal in each case become a temporary shunt, has been more or less fully described by Maury in vol. 1, No. 4, p. 74 of *Engineering News*. For these tests, however, the writer prefers to use both sides of the duplex instrument, by laying off two two-foot distances (three points), only accepting as true those duplex readings which simultaneously agree. This, because he has found that duplex readings so taken on cable-sheaths have not often agreed. Whether such disagreement was due to the imperfect contacts made by the lead terminals or to the use of the cables for alternating transmission can not, however, be definitely stated at present.

The second method, and, as a rule, most satisfactory one, consists in taking the voltage between two points and then immediately short-circuiting them and taking the voltage and ampereage. The apparatus required is a light wagon, a reel, about 500 feet of flexible rubber-covered No. 6 B. & S. wire, the same length of electric light cord, a duplex instrument (ammeter and voltmeter), two single-pole double-throw switches and four heavy iron clamps. About 475 feet each of the wire and the cord (which should have an inner insulation of rubber) are bound together at points about twelve inches apart by means of insulating tape and wound on the reel which is mounted between two upright castings similar to those which will be described in another article. On one of the flanges of the reel and around but insulated from the axle is secured a circular brass ring which makes contact with a brush so held by a brush-holder attached to but insulated from the frame that the brush will make good contact whether the reel is revolving in one or the other direction. The inner end of the cord is threaded through a hole bored in the flange, projecting a few inches beyond its edge. The outside ends of both the wire and the cord are connected in multiple to the bodies of two of the clamps by means of round-head machine screws and copper burrs.

Fig. 1 is a sketch showing diagrammatically the arrangement of the switches and instrument, in which A is the duplex instrument with "two" and "twenty" ranges. The left side, in connection with the two shunts B and C, is used as an ammeter; while the right side is used as a voltmeter. D is a single-pole, double-throw switch, to the middle point of which is connected thirty feet of the heavy wire. E is a small single-pole, double-throw switch, to the middle point of which is connected thirty feet of the flexible cord. To the outer ends of both the wire and the cord are connected in multiple the other two iron clamps. The remainder of the wiring can be traced out without any description.

The two shunts, the two switches, the calibrated leads and the instrument should

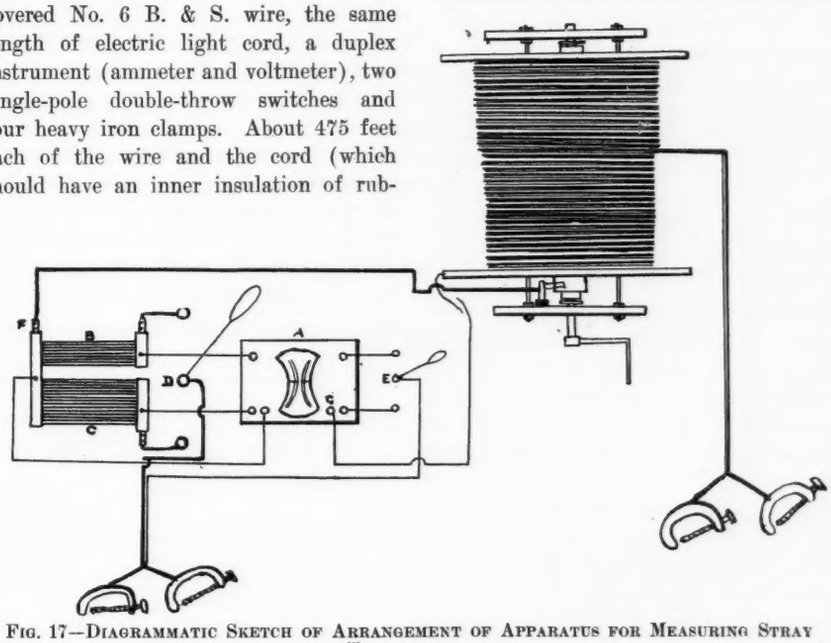


FIG. 17—DIAGRAMMATIC SKETCH OF ARRANGEMENT OF APPARATUS FOR MEASURING STRAY TRANSMISSION.

be obtained from the instrument-makers all mounted on one base; and on no account ought the makers to be directed as to the details. The method of making shunt connections is a question for the instrument expert only.

To install the apparatus, the reel is placed in the rear end of the wagon and the instrument portion mounted on a smooth plank attached to the side of the wagon which is protected by a canvas covering stretched on a light framework. From F (Fig. 1) is run a piece of heavy wire to the brush-holder; and from the binding-post G of the meter is connected a small piece of flexible cord long enough to reach to the end of the cord projecting beyond the edge of the reel.

To use the apparatus, the wagon is taken to a hydrant and the clamps from the reel attached to it. The driver is

then ordered to go ahead to the next hydrant, to which the clamps from the shunt are attached. Care should be used by one of the attendants that the reel does not "run away with itself" when the wagon is moving. Both switches are then thrown down. If the readings are so slight that the lower scales would be preferable, the switches are thrown up instead. When the proper scales have been selected, the ammeter switch is opened and the deflection of the voltmeter needle watched until satisfactory and steady. Then, remembering this deflection, the ammeter switch is quickly closed and both deflections at once noted. The three readings are then entered as voltage before short-circuiting and as voltage and amperage after short-circuiting. To facilitate the entering of the readings, the reader is supplied with sheets similar to those shown in Fig. 18.

The hands required for the operation of the apparatus are a college or other student of electricity at $1.50 per day; a driver at the local rate of pay; two strong active linemen (helpers) at $1.50 a day; and one bright boy at fifty cents a day. The work and data obtained should be in charge of the legal department. The wagon and the hands should report at the office at 8 A. M., and immediately start for the scene of the day's operations. Lunch should be taken at noon and the wagon start for the stables at 5 P. M. The reader should then return to the office and enter on clean sheets the readings which have been taken together with the calculated results. These sheets should then be at once turned over to the legal department which, when considered necessary, will confer with the general manager.

The reader will find it a little difficult at first to remember correctly the three readings up to the time of entering them, but with a little practice the difficulty will be overcome. He can, too, and in time acquire the habit to take not only the steady deflections but also their maximum and minimum fluctuations. Such, however, is exceedingly trying and wears the reader out in quick order.

After the readings are taken at this point, the clamps are unloosened at the second hydrant and the wagon returns to the first one. While so returning the cable is rewound on the reel, and when the first hydrant is reached the other clamps are also unloosened. This performance is then repeated between other hydrants.

The principle of this method is based, of course, on the $C = \frac{E}{R}$ law as applied to divided circuits. To calculate the C, the formula is $C = \left(\frac{V'}{V' - V''}\right) \times C'$ where V' = the voltage before short-circuiting and V'' and C' = the voltage and amperage, respectively, after short-circuiting; or, in plainer words, the transmission in amperes taking place by means of the pipes is equal to the amperage after short-circuiting multiplied by the quotient of the voltage before short-circuiting divided by the difference between the voltage before short-circuiting and the voltage after short-circuiting. Thus, if the three readings are 1.5 volts before short-circuiting, and 1 volt and 2 amperes after short-circuiting, the transmission is

$$\frac{1.5}{1.5 - 1} \times 2 = 6 \text{ amperes.}$$

The third method, while very accurate, can seldom be carried out; and, as it consists of simple ammeter reading, requires no description.

As a preliminary to a description of the fourth method, consider the diagrammatic illustration marked Fig. 19, in which AB represents the track rails, CD the line of pipe and EF a connection between the rails and the pipe. Now, if the resistance of the earth between the rails from G to B and the pipe from H to D, plus the resistance of the pipe from F to D, be high as compared with the resistance of the rails from E to B, the accidental transmission by means of the pipe will be a negligible factor. If, however, a heavy connection be made between B and D with an ammeter inserted the reading obtained will depend upon the load between A and I and the relative resistances of the rails and the pipe line. Such connections as FF and BD often exist through gate-boxes, pipe valves and rails being jammed together; or from accidental contacts between rails and service-pipes or cable-sheaths or bare auxiliary copper returns. That a connection such as EF exists is no reason that a connection should be made between B and D. For two wrongs do not make one right. In such a case, therefore, EF should be removed; even if, for some special reasons, a connection is made between B and D.

Having dealt with the preliminary, the fourth method, which has often been proposed by the writer, but which up to the present time he has been unable to follow, may now be considered. Assume a portion of a straight piece of track forming the suburban or outer end of some

READINGS BETWEEN HYDRANTS.

*Readings taken by*_____

*Date*_____

*Weather*_____

*Preceeding Weather*_____ *for*_____ *Days*_____

READING No.	LOCALITY.	TIME.	BEFORE SHORT—CT	AFTER SHORT CIR'T		CALCU'D	REMARKS.
			VOLTS.	VOLTS.	AMPERES	AMPERES	
	TO	TO					
	TO	TO					

FIG. 18.—PRINTED FORM FOR ENTERING OF READINGS.

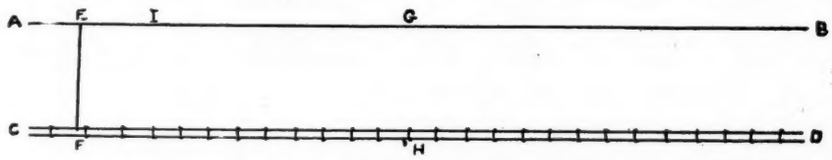


FIG. 19.—DIAGRAMMATIC SKETCH OF RELATION OF TRACK RAILS AND LINE OF PIPE.

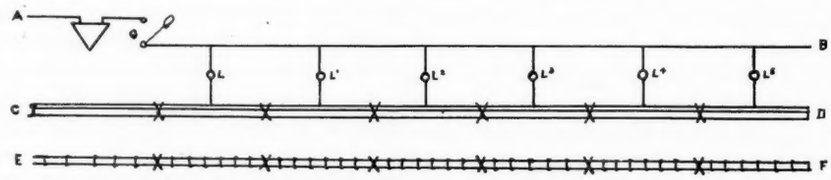


FIG. 20.—DIAGRAMMATIC SKETCH OF RELATION OF TROLLEY WIRE, TRACK RAILS, PIPE LINE AND MEASURING APPARATUS.

line, as represented diagrammatically in Fig. 20, in which AB represents the trolley wire, connected while experiments are being made to a storage battery with an ammeter inserted near A; CD represents the track divided into insulated sections, as shown by the crosses; EF represents a pipe line deadened at both ends and also divided into sections by breaks, as shown by the crosses; and L, L^1, L^2, L^3, L^4, L^5 represent apparatus, each one supplying an equal load of, say, fifty amperes to the track. At all the crosses connections could be made or unmade by means of short lengths of insulated cable with lugs sweated on to the free ends. By bolting the lug faces together, the track and pipe sections, respectively, could be made continuous, or by inserting an ammeter between two lug faces readings could be taken. To use such apparatus the switch G would have to be closed and the ammeter inserted in the trolley wire be watched until it showed a steady load. The ammeter readings would have to be taken at all the points marked with a cross. Voltmeter readings should also be taken between the tracks and the rails. Such tests, carried out first with the rails not bonded and then with the rails bonded, would give some very valuable data to assist in the consideration of the problems connected with electrolytic corrosion. The pipe line would, of course, have to be specially laid and covered up, except at the points marked with the crosses; but could, however, be laid with the intention to use it afterward as a water-main by making up the breaks after completion of the tests.

The writer, like many others, has several times installed apparatus and made tests with a view to find out the values of earthed-plates as transmission mediums in connection with roads operated with grounded returns. Using a large number of copper sheets buried in the ground near the low-voltage bus-bars and surrounded by charcoal, the connection between the plates and the bus-bars being made with a large number of 1,000,000-circular-mil cables, he was unable to obtain any deflection of the ammeter. Using a plate with a surface of about 900 square feet on the bed of a river at a point about one-quarter of a mile from each of two power-houses, and with 500,000-circular-mil cables and connections between the plate and the low-voltage bus-bars of each, he found that the transmission between the plates and one power-house was about three-quarters of an ampere, and between the plate and the other power-house about one-quarter of an ampere; this with a load of about 2,500 amperes. He has also found that ironwork set in concrete forms a much better earth connection than ironwork set in soil when a connection is made through a resistance in each case between the ironwork and the trolley wire of a grounded system. The probable reason for this is that the ironwork set in soil soon becomes coated with a thick incrustation of oxide, which forms a poor connection between the iron and the soil; while in the case of ironwork set in concrete, the iron, having a fairly clean surface when so set, makes a fairly good contact by means of the concrete with the surrounding soil. Small iron pipes running through the inside of lamp-posts to the mains and larger pipes running down to and for a few feet through the ground (even to within a few inches of the rails) form poor earth connections, particularly the latter.

The New Telephone Exchange at Covington, Ky.

By J. E. Peavey.

THE Citizens' Telephone Company, of Covington, Ky., has recently completed and put into service a new telephone exchange at the southwest corner of Fourth and Court streets. While this exchange possesses no great departure from standard practice in manually operated exchanges, it will be found replete with novel ideas, appointments and appliances to facilitate operating and maintaining a high standard of service.

As shown in Fig. 1 the building is a two-story brick, with freestone trimming of a very neat design, adding artistic beauty to the surroundings. The interior arrangement of the building shows a very complete and liberal design from an operating and maintaining standpoint. The relation of operators' quarters to operating room and inspector's quarters to wire chief, as well as relation of departments, have all been faithfully worked out and it is doubtful if there can be found an exchange with so little evident stir and confusion as exists in this one.

The building has an ultimate capacity of 6,000 subscribers and 1,500 trunk lines. The second floor is used entirely as an operating room. The first floor contains the manager's office, apparatus room, wire chief's quarters and operators' quarters, consisting of dining room, rest-room, locker room, kitchen and toilet room. The basement has been arranged to afford plenty of light and air and contains the inspectors' quarters, telephone power plant, heating apparatus and underground cable terminal room. The building is as near

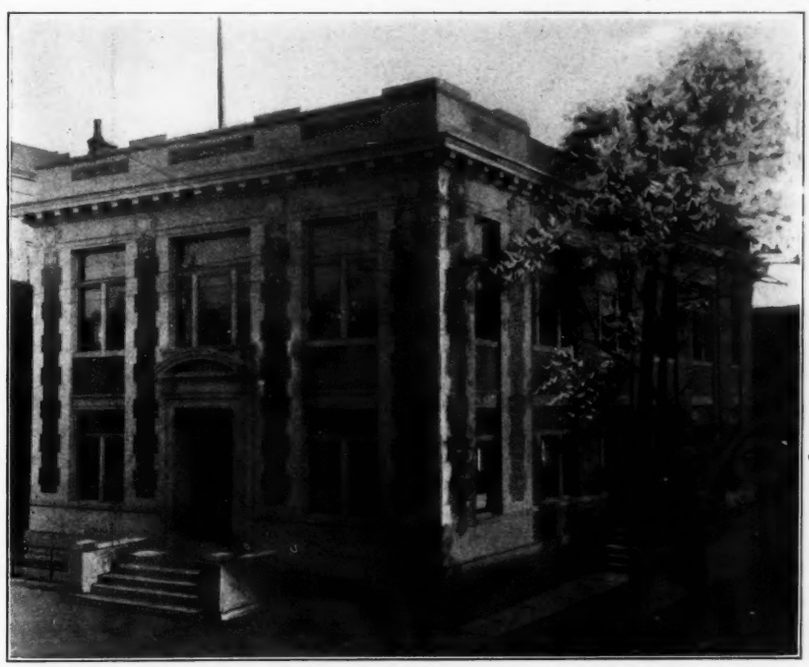


FIG. 1.—EXTERIOR VIEW OF NEW TELEPHONE EXCHANGE AT COVINGTON, KY.

fireproof as can be obtained. The outside walls are of brick and the entire floors, beams and supports are of ferro-concrete construction. In the operating room, manager's offices, dining and restrooms hardwood floors have been laid upon the concrete to give a neat finish with softer tread. The front vestibule, halls, locker room and toilet are finished with very neat and artistic mosaic designs. The apparatus room and kitchen have the natural cement finish, ensuring against fire from any cause within the building. The entire building is heated with direct indirect hot-water system of heaters; ventilators have been arranged to afford a perfect circulation of fresh air, and everything provided that would contribute to the comfort and health of the employés confined within the building.

FIG. 2.—MAIN SWITCHBOARD, TOLL BOARD AND CHIEF OPERATOR'S POSITION, NEW TELEPHONE EXCHANGE AT COVINGTON, KY.

The switchboard is the Western Electric standard common battery multiple-relay type, containing every device and arrangement of apparatus known in the art to afford rapid and efficient service. The power for the exchange is supplied from chloride accumulators. There are two sets of machines for charging the batteries, one generator being belted direct to a Dean gas engine; the other unit consisting of a motor-generator set with generator direct-connected to a General Electric three-phase induction motor. With this arrangement the chances to be without power are certainly very remote. The ringing machines are in duplicate and are operated from the storage battery; every possible chance for an interruption to the service from any source has been amply provided for.

The Citizens' Telephone Company anticipates giving with this exchange a service second to none in the country. This exchange ranks with the best and merits the liberal patronage it has been receiving, as well as being a credit to the city of Covington.

Mr. B. L. Kilgour is president and general manager, to whose labor and forethought is due all credit for the exchange.

India-Rubber Statistics.

The recent advance in prices of and demand for india-rubber lends especial interest to some figures just prepared by the Department of Commerce and Labor through its bureau of statistics, which show the quantity and value of rubber imported in the United States during the current year and in a term of earlier years. These figures show that in both quantity and value the imports of the year about to end will probably exceed those of any earlier year. The largest importation in any complete fiscal year is fifty-five and one-fourth million pounds in the fiscal year 1901, and the highest value in any earlier year is $31,707,630 in 1899. In the calendar year about to end, however, the indications are that the quantity imported will reach sixty million pounds and the value more than forty million dollars. In the ten months ending with October the quantity of crude rubber imported is practically fifty million pounds, or, to be exact, 49,951,326 pounds, and the value was $34,315,180.

In the latest month for which figures are available, October, the quantity imported was 5,397,981 pounds, and the value $3,450,840; so that if the figures of October are an index to the prospective figures for November and December, it seems likely that the total quantity of india-rubber imported during the calendar year will reach sixty million pounds, and the value exceed forty million dollars.

In addition to this, sundry substitutes for crude rubber are, in very recent years, being brought in in large quantities. "Gutta joolatong," or "East Indian gum," a product of Borneo, which is used in conjunction with india-rubber in certain lines of manufacture, has in recent years been imported in rapidly increasing quantities. The rapid increase in its use is indicated by the fact that the quantity imported into the country had been so small that the bureau of statistics made no separate record of it prior to 1899, when only six million pounds were recorded as having been imported. In 1900 the quantity was 8,701,753 pounds; in 1903, 13,984,817 pounds, and in the ten months of the present calendar year for which figures are available the quantity imported was 12,265,801 pounds.

Under modern methods much of the india-rubber used in shoes, garments and otherwise may now be recovered and by certain processes made fit for further use, and the extent to which this is now being

done is indicated by the fact that the importations of "old and scrap rubber fit only for remanufacture," which amounted in 1894 to less than two million pounds, were in the fiscal year 1904 over twenty million pounds.

While Brazil furnishes a much larger share of the rubber imported into the United States than does any other country, the share that country contributes of the grand total of our imports of that article is probably not so large as generally supposed. The figures of the bureau of statistics show that of the 49,951,326 pounds of crude india-rubber imported into the United States during the ten months ending with October, 1904, 28,282,456 pounds came from Brazil, while Africa, Central America, certain other of the South American countries, and the East Indies supplied the remainder. Practically all of the rubber which originated in Africa came by way of Europe, being accredited to various European countries, though, of course, in no case produced in those countries.

The reports of the bureau of statistics credit the United Kingdom with over six million pounds and other European countries with over eleven million pounds, none of which was, of course, produced in those countries, since india-rubber is solely a tropical product. Most of the seventeen million pounds credited to Europe comes from the African colonies of certain European countries, though in some cases from colonies in the East Indies.

The rapid growth in the importation and use of india-rubber in the United States is shown by the following table, which give the quantity and value of rubber imported at five-year intervals from 1874 to 1904:

IMPORTS OF INDIA-RUBBER AND GUTTA-PERCHA, CRUDE, INTO THE UNITED STATES AT QUINQUENNIAL PERIODS, 1874 TO 1904.

Fiscal Year.	Quantity. Pounds.	Value. Dollars.
1874	14,191,320	6,196,729
1879	14,878,584	6,068,088
1884	24,574,025	13,736,004
1889	32,339,503	12,387,131
1894	34,256,546	15,162,333
1899	58,055,887	32,041,626
1904	74,327,584	41,049,434

A further evidence of the rapid growth in the use of rubber in the manufacturing industries of the United States is shown by the fact that the number of establishments manufacturing rubber and elastic goods has increased from ninety in 1880 to 262 in 1900; the capital employed, from six million dollars in 1880 to thirty-nine millions in 1900; the cost of materials used, from nine million dollars in 1880 to thirty-three millions in 1900; and the value of products, from thirteen and three-fourths millions in 1880 to fifty-two and one-half millions in 1900. Practically all of this large manufacture is absorbed by the home market, the exports of rubber manufactures having amounted to only $4,435,590 in the fiscal year 1904, while the imports of manufactures of rubber amounted in the same year to $1,157,042.

Recent Tests of Steam Turbines.

A 500-kilowatt, continuous-current Curtis steam turbine set, erected at the Cork (Ireland) electric tramway and lighting system, was tested recently by Mr. Charles H. Merz, the object being to determine the steam consumption at different loads, these being, respectively, one-quarter, one-half, three-quarters, full and one and one-quarter of full load. The actual results in pounds of steam per kilowatt-hour were as follows: at one-quarter load, with 28.8 inches vacuum, fifty-one degrees superheat, and a steam pressure of 155 pounds, 24.9 pounds of water per kilowatt-hour. At one-half load the consumption was 22.64 pounds, the vacuum being 28.6 inches, and the superheat fifty-one degrees. At three-quarters load the consumption fell to 20.95 pounds of water, the vacuum being 27.9 inches, and the superheat seventy degrees Fahrenheit. At full load the consumption was 20.6 pounds, the vacuum being 26.9 inches, and the superheat 104 degrees Fahrenheit. The steam pressure had fallen to 153 pounds. At twenty-five per cent overload the consumption was twenty-one pounds of water, the vacuum being 26.2 inches; the superheat, 124 degrees; the steam pressure, 151 pounds. Correcting these figures so as to give the consumption corresponding to 28.66 inches of vacuum and 115 degrees superheat, the following are the results: at one-quarter load, 23.8 pounds of water per kilowatt-hour; at one-half load, 21.2 pounds; at three-quarters load, nineteen pounds; at full load, eighteen pounds, and at twenty-five per cent overload, 17.8 pounds.

During the first week in November the trials of four vessels of the British navy, one of which has been equipped with steam turbines and three with reciprocating engines, were completed. The results were favorable to the turbine equipment, as they showed an economy over the reciprocating engines of about twenty-three per cent. Thus, the turbine, in addition to the saving in space, increases in the proportion mentioned the radius of action of the vessels equipped with it. This condition, however, obtains only when running at eighteen knots. For a lower speed the reciprocating engines show greater economy. The best value obtained for the turbine was 13.8 pounds of water per horse-power-hour. This is with a speed of twenty knots. The consumption of the reciprocating engines for the same speeds was about twenty pounds.

The Production of Platinum in 1903.

The world's production of platinum ranges annually between 160,000 and 170,000 troy ounces, but the production of platinum in the United States in 1903 was only 110 ounces (worth $2,080), and even that was sixteen ounces more than the output of the previous year. Russia is the fortunate country which produces about ninety per cent of the world's platinum. The remainder comes mainly from Columbia, South America.

During the year 1903 the centre of interest in platinum mining in the United States shifted from Shasta and Trinity counties, California, to southern Oregon. There, in the neighborhood of Grants Pass and Kerby, platinum and iridosmium are found in the place of gold. Associated with the platinum and gold is another heavy mineral called josephinite, which is a natural alloy of iron and nickel. It also has proved commercially profitable.

The production of 110 ounces of platinum sand does not include the platinum contained in the copper ores of the Rambler mines, Wyoming. It is interesting to note that $6,000 worth of platinum was obtained in 1903 in the form of slimes in the treatment of the copper ore and matte from this region.

The imports of platinum during 1903 show how inadequate is our home production. The total value of imports amounted to $2,055,933, which were distributed as follows: unmanufactured, 1,426 pounds ($328,103); ingots, bar sheets and wire, 6,308 pounds ($1,591,-941); vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $128,890; articles manufactured of platinum, $6,999.

The price of pure platinum in wholesale quantities at New York continued during the whole of 1903, as during the last seven months of 1902, at $19 an ounce.

The above figures are taken from a report on the production of platinum in 1903, which is included in the forthcoming volume, "Mineral Resources of the United States, 1903," published by the United States Geological Survey, Charles D. Walcott, director.

The Quality of Telephone Service.

By Samuel G. McMeen.

TELEPHONE service wholly between people in the same town or between correspondents in separate towns is subject to variations of quality in two principal ways. One of these is a variation in the goodness of the actual transmission of speech, and the other is a variation in the excellence of the steps required to get the lines connected for the conversation, and disconnected after it.

Excellence of service and clearness of transmitted speech are of the highest importance in long-distance work, and it has been suggested by a prominent engineer in a discussion upon this subject that with the best conditions of to-day, operated in the best known way, the possible radius for long-distance talking from any point is definitely limited, and on the edge of the area indicated by this radius is a zone in which successful talking is likely to be out of the question at one time or another. In such long-distance work, therefore, the more important problem is that the lines, instruments and switching appliances be such as to enable the conversation to be commercially satisfactory, and the questions having to do with the speed of connection and disconnection are relatively of smaller importance.

In local telephone service, however, making up by far the greater bulk of telephone activity, it is now relatively a simple matter to provide and keep in order satisfactory conditions for uniformly successful commercial conversation. As it is possible wholly to eliminate primary batteries at the subscribers' stations, and to supply current for transmission from a central point, the old difficulty of transmitter current supply has ceased to be a bugbear. The market is full of transmitters of designs good enough to ensure acceptable local transmission. The real problem, therefore, is that of getting the connections made and unmade at a rate of speed high enough to satisfy all reasonable expectation of the subscribers, and at the same time keep reasonably reduced the expense of switching.

It has often been suggested that the operation of a telephone exchange for the production of local service is nothing more nor less than a manufacturing problem, the product in such a work being local telephone service. In a very large degree this analogy is exact, and so far as it is so there seems to be no reason why the accumulated experience of manufacturers of other commodities should not be utilized by the maker of telephone service. It requires but little close observation of the daily methods of telephone exchanges to find opportunity for applying the experience of other manufacturers to the result of an improvement in local service, and a reduction of its cost. One of the most illuminating results of such a study is to reach a simple understanding of what local telephone service really is, and what are the elements of which it is composed.

Without attempting too great a refinement, it may be said that the following items represent the elements which operators in manual exchanges must contribute to the making of the service:

1. Prompt answering.
2. Prompt disconnection.
3. Freedom from errors in connecting with the called line.
4. Promptness in connecting with the called line.
5. Courtesy and the use of form.

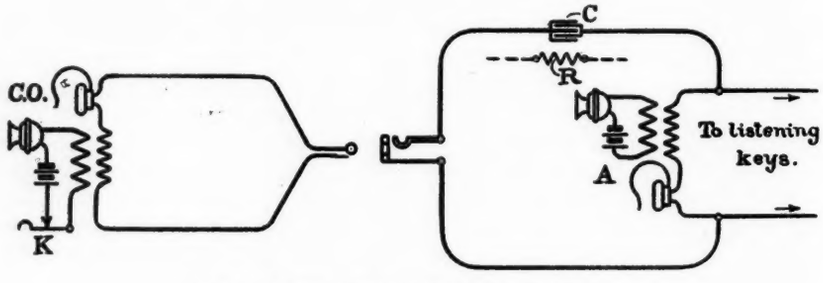


FIG. 1.—CHIEF OPERATOR'S LISTENING CIRCUIT.

6. Freedom from failure by busy lines and failure to reply.
7. Clear enunciation.
8. Team work.

It is to be admitted that there is some interrelation between these elements, as for example, that of the last assisting to accomplish the first. It is also to be commented that in an effort to determine the quality of the service made, many managers are content if the answering service is prompt. We have long been accustomed to hearing the quality of service measured in terms as to the number of seconds required to answer the subscriber's signal, and if such a standard were sufficient, exchanges giving quick answering would be found to give the best service in other ways. Only a little enquiry and service are necessary to show that this is rarely true; so that if we are to know the real quality of the service manufactured, we must have more definite information and it must be such as is collected by patient and systematic work.

The best method of determining the speed of answering is by recording the results of a long series of observations on actual calls made by the observers, and making an accurate analysis of the results. To enable the performance of a given operator to be studied with relation to the performance of others, and in comparison with a standard, the clearest and most truthful statement is found by dividing the test calls upon that operator into groups, of various numbers of whole seconds each, and comparing the percentages of these with the whole number of tests. For example, assume each of the calls to a given position to have been answered in ten seconds or less, in which:

One hundred per cent are answered in ten seconds or less.

Eighty per cent in eight seconds or less.

Sixty per cent in six seconds or less.

It is probable that a reasonably uniform service will show only a small percentage answered in three seconds or under.

It is very simple to draw these percentages in the form of a curve, and to see at a glance the value of an operator with reference to her skill in prompt answering, while the average time of answering and the number of calls in the busiest hour might not give any such clearness of understanding.

Prompt disconnection where relay boards are used is possible to an astonishingly greater degree than before the introduction of lamp signals. Observations made in New York city before the installation of any relay boards showed an average time required to disconnect of over seventeen seconds. Five years later, after the completion of a relay switchboard equipment throughout Manhattan island, the average time taken to discon-

nect was something under three seconds. The excellence of relay apparatus in this particular has led subscribers to a larger traffic, and to the making of calls which come close upon the heels of one another. A most important rule is that a signal for disconnection shall be given prompt attention either by the operator who made the connection or by a monitor who may be assisting; and another, still more important, is that in the case of a flashing lamp, indicating a recall, such a signal shall be given precedence over all others.

It goes without saying that items 3 and 4, covering the promptness and accuracy of connecting with the called line, are vital, and yet that a large percentage of errors in these elements might exist in an exchange having a very high average speed of answering the originating call. Indeed it seems quite the rule that where the effort of the management is devoted toward securing and maintaining extreme speed of original answering, all the other elements suffer in due proportion.

As to item 5, it goes without saying, of course, that operators should be courteous; but it is necessary to say it, and keep saying it in the most effective form, in order to prevent human nature under the most exasperating circumstances from lapsing a little from the standard, however high. The use of form assists both the operators and the subscribers, because in all matters of strict routine it is much easier to secure high speed and great accuracy by making as many as possible of the operations automatic. The use of the word "number" and other well accepted formalities has assisted greatly in securing speed, clear understanding, and accurate performance. The simple expedient of spelling numbers by repeating the figures in a detached form (as "1-2-5" for 125) has taught subscribers the same expedient, and the percentage of possible error is materially reduced by going one step further and having the operator, in repeating, use always the opposite form from that spoken by the calling subscriber.

The old impression of the public to the contrary notwithstanding, the operator has no control over the "busy line" and "don't answer" situation. It is, however, of high importance that the management should know by the analysis of repeated and exhaustive tests of the service, to what extent these troubles are degrading it. In addition to improving the service by the elimination of busy reports, there is no means of increasing revenue which is so easy and so uncertain as that which comes from following up the tabulated results of busy calls.

It must be remembered that clear enunciation for telephone purposes is a matter wholly relative, and the ability of an operator in this regard can be determined only by a close analysis of many observations from the standpoint of a subscriber. A trick of speech rather than a pleasant voice and an easy address has made the answering ability of many an operator captivating to a group of satisfied subscribers.

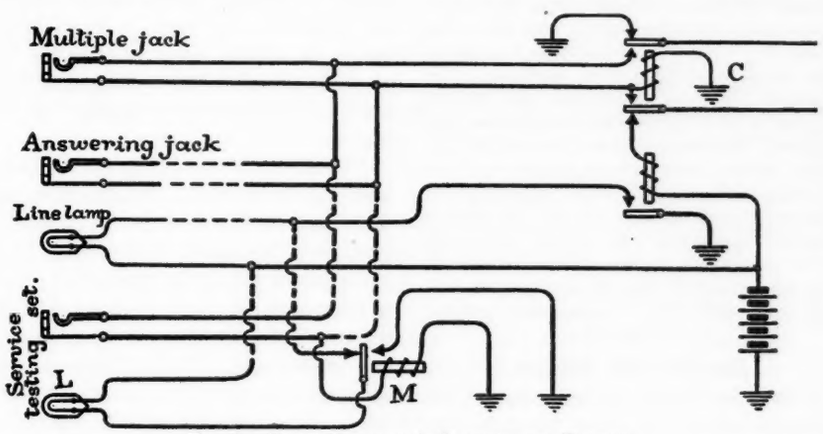


FIG. 2.—CHIEF OPERATOR'S SUPERVISING CIRCUIT.

By team work is meant the ability of a group of operators, seated side by side, to work together as a unit in caring for the service brought to them by the answering-jacks within their reach. In switchboards of the construction usual to-day, a call before any operator may be answered by her, or by the operator at the right or the one at the left of her position. In many exchanges this advantage is wholly overlooked. In the period of general redesign of central-office equipments about eight years ago, a switchboard was installed with mechanical visual signals and answering-jacks on a flat-top board, and an arrangement of operators such that the signal of any call was extremely prominent, and in easy reach of each one of four or possibly five operators. Associated with the line signals within the reach of such a group was an auxiliary lamp signal which would light when a call was made by any of the lines so terminating. It was found that with this arrangement the calls were answered in a strictly even manner, special rushes being cared for by the joint efforts of the group rather than serving to swamp the operator who happened to be in charge of the particular section affected by the rush.

This principle has been tried out in so many ways that it is astonishing that it is not recognized as being a vital one. The whole matter is accomplished by impressing upon each operator that it is her duty not to answer the calls of a specific number of lines before her, but to answer with such promptness as is possible any call which is within the reach of her answering equipment.

All that is required to be known concerning the form of address and courtesy may be learned by a close observation of the operators' work by the chief operators and monitors, and by the use of listening circuits permanently connected to the operators' sets. It is naturally necessary that the use of these listening circuits by the chief operator or her assistants must not be known to the operators at the times of use, even though they may know of the existence of such facilities.

Fig. 1 illustrates a simple schematic arrangement of such circuits, the chief operator's set being marked CO, and the subscribers operator's set marked A. By opening the contact at the key K associated with the chief operator's set, all sounds from her transmitter are kept from the listening circuit. The fact that the primary winding of the induction coil is in open circuit while this key is open, increases the impedance of the secondary of the induction coil to a considerable degree. The condenser C in series with the listening circuit assists this high impedance in keeping the current taken by the listening circuit from becoming noticeable in the operator's set. If desired, the condenser C may be replaced by a high resistance, as R. With such an arrangement, or one similar to it, it is quite impossible for an operator to know when such listening-in occurs.

For the purpose of carrying on the routine tests, it is of course possible to have an observer walk about the town, call upon subscribers, and make calls from their telephones. This for many years was the accepted method, and it had the real

advantage of bringing a representative of the operating company into contact with the subscribers. Experience has shown, and good judgment indicates, that this is not the best way to get good results. Visits upon the subscribers are important and necessary, but ought to be devoted to the promotion of acquaintance, and to finding out what needs the subscriber has which remain unfulfilled, as well, of course, as to promoting his education in the use of the telephone service. For the making of test calls upon the operators, other expedients are available. If the office in which the tests are to be made is provided with an incoming trunk switchboard, or even an incoming trunk position cooperating with the tollboard, a trunk may be chosen at such a position and devoted, part of the time at least, to the making of test calls. Wires should be led from this trunk plug to a desk located outside of the operating room, and having facilities for testing the called line after the plug is inserted, and listening upon it without closing it, so as to place a call before the operator if it is not in use. A condenser in series with the conductors will accomplish this, and a key to short-circuit that condenser will place a call when desired. A stop-watch and record sheets will complete the equipment for testing originating calls.

It is often necessary to supervise the line of a given subscriber for a long enough time to enable it to be determined whether his complaints are well founded or not. A service-testing desk, or the service-testing part of the chief operator's desk, should be provided with equipment enabling every call from such a line to be set in duplicate upon such a position. The equipment also should include means for knowing when a call is made for such a line.

Fig. 2 illustrates one possible form of such an arrangement. When it is remembered that a plug in any jack of the line at the switchboard proper will operate the cut-off relay C, and that three of the heavy dotted lines leading to the service testing set are merely attached to the line under test at the intermediate distributing board, it will be seen that all calls, whether incoming or outgoing, may be observed, and that the operation and character of the connection may be determined by listening with such a set as is shown in Fig. 1.

All that is required is that the signal at the service-testing desk be such as to respond to calls for or calls from the central office; and with this in mind it should be found easy to design similar and simple circuits to cooperate with any form of common battery switchboard. For observation upon magneto lines, a simple jack and bridging drop are all that are required, because the signal to the central office and the signal from it are electrically alike.

There are exchanges of considerable size in which private branch exchanges have not been installed to a sufficient number to make that phase of the business a real problem in itself. These exchanges are rapidly dropping into the minority, as it is more and more generally recognized that the private branch exchange is a phase of telephone working which is equally essential to the success of general business and the telephone traffic as well. In one district of a large city there are more operators working at private branch exchange switchboards than are working in the central office which receives the trunk lines from them. Some such result is sure to occur in every exchange. Because the private branch exchange operators are not under the attention of skilled supervisors, and often because they have other duties than the care of the small switchboard to perform, it is possible for them to degrade the general character of telephone service in a marked degree. At any reasonable sacrifice, the duty of the operating company is clear in that it should secure and retain a fair degree of control over private branch exchange operators, and should cooperate with employers to the fullest extent in the education of the local operator and the principal users of the local service.

The Faraday Society.

The ninth ordinary meeting of the Faraday Society was held November 23, 1904, at the Institution of Electrical Engineers, London, England, Mr. W. R. Cooper in the chair. The chairman moved that the hearty congratulations of the society be tendered to the president, Sir Joseph Wilson Swan, on the occasion of the recent dignity which had been conferred upon him by the King. The motion was carried unanimously amid applause.

Professor L. Kahlenberg, Ph. D., presented a paper on "Recent Investigations Bearing on the Theory of Electrolytic Dissociation," which, in the absence of the author, was read in abstract by the secretary.

In creating the theory of electrolytic dissociation the phenomena of actual electrolysis have played a minor part. It has rather been based on the observation that for many aqueous solutions the molecular conductivity increases with the dilution, and that the osmotic pressure, lowering of freezing-point, and similar physical constants are abnormally great. The hypothesis is thus vitally connected with van't Hoff's theory of dilute solutions which it generalizes in the form $PV = iRT$, where i, the so-called degree of dissociation, is unity for non-electrolytes, and greater than one for electrolytes. The author is of opinion that the theory is supported by isolated facts only.

Comparisons of the molecular conductivities with the freezing-points at zero degree and boiling plants at ninety-five degrees were made by the author in 1901, with typical solutions of electrolytes and non-electrolytes, and no such connection between those quantities as demanded by the theory was found.

According to the theory, molecular conductivities should increase with the volume, but in practice that is often not the case.

According to the Nernst-Thomson rule, the dissociation is caused by the high specific inductive capacity of the solvent, but cases are cited, such as liquid hydrocyanic acid, where a higher dielectric constant than water has is accompanied by lower conducting—and therefore ionizing—power.

Additive properties are not a valid argument favor of the theory, because they occur in quantities such as molecular heats and molecular refractions, where ionization is out of the question.

The colors of solutions have been attributed to the free ions present, but copper, nickel and cobalt oleates are insulators, and yet bear the characteristic colors of the supposed metallic ions.

Instantaneous reactions sometimes occur between insulating solutions, and hence can not be regarded as taking place between the free ions present.

A strong argument against the hypothesis is that it can not be harmonized with the law of mass-action. The agreements obtained by Ostwald in his application of the dilution law to solutions of weak organic acids are only very rough, and to electrolytes par excellence it can not be applied at all. Rudolphi's and van't Hoff's amended formulæ are purely empirical.

The power of coagulating colloids has been ascribed to free ions, but such power is not confined to solutions of electrolytes.

It is in the realm of non-aqueous solutions that the theory proves especially impotent. We now know of such solutions that conduct electricity even better than aqueous solutions, and yet yield higher molecular weights than those computed from the formulæ of the solutes. The researches of Walden on liquid sulphur

dioxide are quoted as being particularly conclusive.

The theory has been applied to fused salts. The author questions the validity of such application to what are practically 100 per cent solutions; the hypothesis is avowedly only strictly true for infinitely dilute solutions.

Professor Kahlenberg does not think the hypothesis can be retained even in a modified form. It must give way to a conception which takes into account the affinity—of the same nature as chemical affinity—between solvent and solute. "The processes of solution and chemical action are identical in character, and chemical compounds are merely the cleavage pieces of solutions placed under special stress or duress represented by the so-called purifying processes." Thus chemical action is merely a special case of solution, and the process of solution is the general case of the interaction of bodies resulting from their specific attractions for one another. A dilute solution is merely a limiting case. The abnormal values of molecular weights of substances in solution as determined by change of vapor tension, freezing or melting-points, is merely a measure of the affinity between solute and solvent, and has nothing to do with any supposed dissociation; the calculation of molecular conductivities is founded upon the erroneous supposition that the solvent plays no part in the conduction. Recent determinations of osmotic pressures by the author have similarly shown that these depend on the nature of both membrane and liquids, and are by no means in accordance with the requirements of the gas laws. Here, again, as in solutions, affinity is the determining quantity.

Mr. W. C. D. Whetham, in a written communication, pointed out that the problem of the nature of solution was independent of the difference between electrolytes and non-electrolytes, which was all the theory attempted to explain. The ions must be conceived as being free from each other, not from all chemical combination, in order to explain the observed phenomena of conduction.

Professor Abegg also sent in a written communication. Professor Kahlenberg's reasons for doubting the theory are merely facts, which can not be explained by the Arrhenius theory alone. The latter explains that behavior of dilute aqueous solutions, where the non-ionized molecules are, as a rule, not associated, and not cases where association occurs, such as in non-aqueous solutions. The author further overlooks the fact that conductivity depends on the mobility of the ions, as well as on the degree of ionization. The theory can be harmonized with the law of mass-action, as the work of Rothmund and Drucker and Jahn has shown.

Dr. G. Rudorf referred to the question of the color of solutions, and showed that on the assumption that the molecule of copper sulphate has nearly the same light-absorbing properties as the ion, all difficulties disappear. The theory quite explains the reactions mentioned in benzine solution, if only very few ions are assumed to be present.

Dr. T. M. Lowry said that Professor Kahlenberg's criticisms were mostly expended on a theory which was not the dissociation hypothesis as conceived to-day. The theory does hold good for concentrated solutions, only we are not yet able to measure the degree of ionization in such cases. The gas laws are not quite true for moderately dilute solutions, because some of the molecules of the solutes are in combination, and not free. He dealt at length with the various points raised by the author.

Dr. H. Borns showed that Professor Kahlenberg's capital mistake was that he attacked everything that had ever been said or done with the theory. He ignored recent modifications of it that the ideas of hydrolysis, complex ions and associations have caused.

A communication was received from Dr. H. Sand dealing with the differences between the theory of Clausius and that of Arrhenius, and discussed some of the approximate assumptions that lead to numerical disagreements in the applications of the latter.

Dr. C. H. Desch discussed Professor Kahlenberg's experiment with copper oleate in benzine solution, and described some experiments of his own bearing on the subject. He thought the difficulties raised by non-aqueous solutions very serious ones.

Mr. F. S. Spiers drew attention to the theory of Traube, which gave numerical expressions to some of the conceptions of solution apparently held by Professor Kahlenberg, and explained the Arrhenius coefficient i in terms of the affinity between solute and solvent.

Mr. F. J. Brislee, M. Sc., communicated a paper, entitled "The Potential of the Hydrogen-Oxygen Cell," which was read by Dr. F. M. Perkin.

Measurements of the potential of the combination $Pt_{H_2} / \frac{N}{1}$ acid / Pt_{O_2}, show different results when the oxygen electrode is charged with oxygen electrolytically, or charged by passing oxygen gas through the liquid. Experiments were made to determine the influence of hydrogen peroxide, ozone and persulphuric acid upon the oxygen potential. The results obtained showed that the addition of hydrogen peroxide lowered the oxygen potential, while addition of ozone and potassium persulphate raised it.

By employing electrodes of extreme thinness (prepared by depositing platinum on glass), the same potential of the combination was obtained independently of the method employed for charging the electrodes. This potential showed a good agreement with that calculated from the Helmholtz formula.

Mr. H. L. Joly, referring to the effect of persulphates, said that in accumulators it had been proved that their presence did not account for the rise of electromotive force on charge.

The Water Powers of Texas.

In proportion to the size of the state, the water resources of Texas are not sufficiently abundant to make conditions in that commonwealth ideal for the farmer or the manufacturer. In addition to the main rivers of Texas there are about twenty streams west of the Colorado river, which rise in springs and constitute potential factors in the water supply and water power of the state. These springs are principally in the Edwards plateau, exceptions, however, being those at Fort Stockton, Santa Lucia, and the head of Toyah creek, in trans-Pecos, Texas. In many localities the water power is only partially developed, but there are many plants in the state with modern machinery, and which obtain a high efficiency. A large number of the plants at present in operation are on the Guadalupe, Colorado and Brazos rivers and their tributaries. The Guadalupe river is the most effective power-generating stream in the state. There are other power plants located on the Neches and Sabine rivers and their tributaries. These plants are small, however, usually being of from six to thirty horse-power, and drive mills for ginning cotton, sawing lumber or grinding corn.

The eastern part of the state is heavily wooded and is traversed by a number of small streams which are tributaries of the Sabine river or the Neches river. They are not subject to any great fluctuations in height. Leaves, roots and low-growing vegetation, which cover the ground in this portion of the state, hold the water back and it flows off gradually, so that it is seldom necessary to shut down a plant on account of low water. In western Texas the power plants are of greater size, but the streams are subject to sudden rises and falls, especially the streams that flow through the Edwards plateau, namely, the Colorado, Guadalupe and Neuces.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

A NEW FORM OF ELECTROPNEUMATIC DRILL.

The idea of compressing the air to be used in rock drills, at the working face, has borne fruit in another direction. An English inventor has followed the method employed in the Siemens and Gardner electric percussion drills, and has arranged a small compressor, that can easily be carried about, to be placed on the floor of the mine, in the immediate neighborhood of the hole to be drilled, the compressor having an electric motor attached to it and working it, while from the two ends of the compressor cylinder two hose pipes are taken to the drill. The drill itself is very similar to the usual air drill. It has a piston and rod, to which the drill is attached, and there are valves in front and behind the piston, admitting air to force the piston forward and to drive it back, and the usual rifled groove to give the twisting motion to the drill, a spring to cushion the drill behind, and the usual hand-feed gear. The main lines of the arrangement, compressing the air near the working face, and using the compressed air to work the drill, have long been used in Germany, with considerable success. The novelty of the present arrangement as I understand it is the same air is used over and over again, and there is no storage of compressed air. The suction side of the compressor is the exhaust side of the drill, and the push given to the piston of the drill is the push given to the piston of the air-compressor, the push being transmitted by the air. The arrangement presents certain advantages; as, for instance, the trouble of the freezing of the moisture carried by the air into the parts of the drill should be got rid of by expansion of the air also due to the heat generated in compression will act in the direction in which it is wanted, in the direction in which the work has to be done. It should add to the push given to the piston of the drill, and so increase the efficiency of the whole system, by cooling also that takes place, owing to the larger space occupied by the air after the drill piston has moved forwards, and the compressor piston has also begun to recede, will again be in the direction of greater efficiency. It is always unwise to accept statements of what an apparatus has done in granite, or, in fact, under any but actual working conditions, and therefore I do not lay any stress on the tests stated to have been made, but the apparatus has, in my opinion, the makings of efficiency, if the details are properly carried out. Remembering that with the ordinary air drill twelve horse-power is required in the compressor on the surface, to drill holes that can be drilled with one to two horse-power, there is great room for invention. Compressing by electric motor does away with the great losses by leakage of air in transmission and the closed air circuit arranged would appear also to get rid of a good many of the other losses.

ELECTRICALLY DRIVEN FANS FOR MINES.

I have before pointed out in these notes that there is a great opening for electrically driven fans in mines. Perhaps I may accentuate the statement by mentioning that the laws governing the passage of ventilating air currents are the same, with very trifling variations, as those governing the passage of electric currents through conductors. The fan that is used to ventilate a coal mine occupies the same position, with regard to the ventilation, that the electric generator does with regard to an electrical supply service on the continuous-current two-wire system, and the main airways, the maincast and exhaust shaft, and the intake and return airways occupy the same position as the main feeders, or supply cables in electric work. To direct an air current across a working face it is simply bridged across between the intake and return airways, just as a lamp or motor would be bridged across a pair of electrical main cables. Further, the pressure is greatest between the entrance to and exit from the fan, practically between the top of the upcast and the top of the downcast shafts and the pressure or difference of pressure between the two roads becomes less and less as the roads recede from the shafts, and it is here that in my opinion electrically driven fans might do some good work.

ELECTRICALLY DRIVEN AIR BOOSTERS.

The "booster" derived, like so many other things electrical, from America is now generally used wherever it is required to raise or lower the pressure for any particular purpose, and air boosters might be similarly employed consisting of fans electrically driven from the service of the mine, and arranged to create an additional pressure at different parts of the mine to which it is difficult to direct the air current, or where the resistance is unavoidably high as across working faces awkwardly situated with regard to the main airways. In fact, I should be inclined to think that a system of ventilation requiring less of the severe draughts and experiences now on the main roads might be arranged, by a free use of air boosters for the working faces. In pillar and stall, and panel working air boosters should often be of great service. It must be understood, however, that the air booster must be arranged in the air circuit for which it is to supply additional surface, and that the whole of the air to be dealt with must pass through the fan. Merely churning of the air will not do. A distinct difference of pressure must be created between the two sides of the fan, inlet and outlet, by reason of which air either passes into the road to be ventilated, or is sucked through the road from the main intake.

The pressures used with ventilating currents are very small. They are measured in inches of water gauge, one-inch pressure representing rather over half an ounce per square inch. In British mines, very low pressures, two inches, and thereabouts are used, as British mining engineers consider it safer. On the continent much higher pressures, up to five and six-inch water gauges are used. The pressures created by screw fans are very small indeed, never greater than one-half-inch water gauge, but with centrifugal fans practically any pressure can be obtained. In my opinion there will be places in coal and other mines where screw fans used as "air boosters" will do good service by giving the air current a boost in a particular direction.

THE POWER REQUIRED.

The power required for driving fans follows the same laws, practically as electric currents. The weight of air moved per minute, multiplied by the distance through which it is moved in feet, divided by 33,000, gives the horse-power in the air; this multiplied by the figures for the efficiency of the fan, and of the electric motor driving it, give the electrical energy that must be delivered at the motor terminals.

Put in the form of an equation where

$$P = \frac{h \times Q \times K}{33{,}000}$$

is the power required, has the pressure, or its equivalent column of air, and Q is the number of cubic feet of air moved per minute, and X the weight of a cubic foot of air. It is worth noting that the pressure created by a centrifugal fan

varies as the square of its speed with a constant resistance.

ELECTRICAL AIR BOOSTERS IN METALLIFEROUS MINES.

But it is in metalliferous mines, gold mines, tin mines, and the like, where the electrically driven air booster should be of the greatest service. In coal mining ventilation is well understood, and if it is not always as well carried out as it should be, it is not due to ignorance. Colliery managers find in some cases, and think they do in others, that it is cheaper to increase the power of the fan, than to keep the roads in such condition, offering as few obstacles and as smooth surfaces as possible, so that the resistance to the air current is reduced to a minimum, but with metalliferous mines, almost without exception, ventilation is left to the care of itself. In metalliferous mines there are often several shafts with levels opening out at different depths on each side of the shaft, and with "winzes" or "raises," small shafts, at intervals between the levels, and connecting them. It is thought, that as the shafts are open to the atmosphere, fresh air will find its way in, just as it was thought about the Central London Railway. The fact is, the existence of a number of shafts, unless some means is taken to render the pressure in one or more of them lower, or higher than in the others, and to regulate the passage of the air from those at higher pressures to those at lower pressures, is against ventilation. Each shaft carries its own column of air, of about the same weight, and there is very little reason for movement of the air at all, none for what we understand by ventilation.

THE REMEDY.

The remedy is to take hold of the air and guide it by partitions and by booster fans, aided by one or more main fans, down one shaft, and up another, or more. It is of no use putting a fall at the entrance to a level some distance down a shaft without other arrangement when there is another level opposite it. The fan may draw some air from the shaft, but it will probably draw nearly all from the opposite level. If the entrance to the opposite level is closed with air-locked doors, which need not be very elaborate, the air will pass from the fan into the open level, and by properly arranging booster fans, it might be carried into every shaft, cruse, raise and working, and the foul air carried up the shaft. It is no good churning the air up, it must be directed just as an electric current is, by suitable paths and by differences of pressure in the right direction. Testing is not difficult in these matters. Use a pressure gauge if you like, but a lighted candle or a light ribbon will give reliable indications to the experienced miner, which way his air current is going and how strong it is. Electrical work is under a cloud at present. It is on the lower portion of the trade curve, and the keen competition in mining with the labor difficulty in some mining districts, reaches the question of ventilation, are of very good importance and should afford a good opening. A well managed British coal mine is a fairly healthy spot, a metalliferous mine is very rarely so.

A New Danger to Telephone Lines.

By J. C. Kelsey.

THE series alternating-current motor has proved to be commercially successful. It will eventually be installed in connection with every interurban electric railway system, and possibly with many urban systems. It will displace the direct-current motor, with its accompanying rotary-converter system and high cost of attendance. By means of autotransformers on the cars exceedingly high pressure can be maintained on the trolley wire, and the expensive feeder system thereby dispensed with. The first installations will possibly use 2,000 volts maximum, while the future holds a promise of a pressure as high as 10,000 volts. That this new condition is a danger can not be denied—a serious one, too—for never before, except in case of accident, has an alternating system been operated except on a highly insulated metallic basis. With grounded alternating trolley system, the neighboring telephone lines will be subjected to widely varying potential, so extremely high with respect to earth that the present standards of telephone line construction will not be able to resist the effect of the strain, and it is safe to say that extremely noisy lines will be the rule, where quiet lines exist at the present moment.

The problem of noisy lines is not new to the telephone interests. The noisy troubles began with the arc light and the direct-current trolley systems, and the prospects are that the troubles will never end in the march of improvements in lighting and power systems. The grounded trolley system forced the telephone interests to put their grounded lines on a metallic common return basis. This makeshift eliminated the worst factor of disturbance, which is earth currents. But the metallic return line was not exempt from the effects of induction, and was noisy, though not disagreeably so.

Fortunately the inductive effects of a direct-current trolley system are comparatively mild, as the changes in the current and pressure conditions are slight. One hears the accelerating of the car motors, due to the changes in the effective pressure, acting on the motor armatures. With good feeder and return conditions the only disturbing effect would be the slowly changing effective pressure, ranging from zero to ten or fifteen volts, governed by the motorman's controller. If alternating current at 500 volts existed on the trolley wire, the changes are extreme and regular, and the entire generator pressure is effective in inducing charges on the telephone lines. It would seem then that the alternating note would be fifty times louder, and would act to the exclusion of all other sounds.

The metallic circuit eliminates the inductive effects if the wires are of same size and resistance, judiciously transposed, and all conditions balanced. Whatever the amount of the charges they will be neutralized, and the bridged receivers will detect nothing. As the charges have a potential slightly above ground, due to changes in the 500-volt direct-current trolley potential, the resistance of the insulation must be great enough to prevent leakage. But text-books say that there must be leakage, as it tends to reduce the capacity of a line and gives voice tones clearness at the expense of volume. But this leakage must be well distributed all along the line. Whether this leakage will be a benefit under the new conditions to be met is a question.

Mr. Ralph Mershon explains the static induction effect of charged clouds upon transmission wires somewhat in this manner (American Institute of Electrical Engineers, Niagara Falls): suppose a cloud heavily charged with positive electricity approaches a transmission line. There is induced a negative bound charge

and a free positive charge. If the cloud moves up slowly, the free positive charge will have time to escape through the natural leakage of the line. But if the cloud moves up swiftly, the free positive charges accumulate, because the leakage can not carry it away, therefore attain a high potential and jump across the insulation to ground. If the cloud moves away slowly the negative bound charge is set free and escapes through the leakage. But if the cloud is suddenly discharged, as lightning, then the negative bound charge is set free so suddenly that the natural leakage of the line can not begin to carry off enough of the charge to prevent an extremely great accumulation of charge, and it breaks through the insulation to ground.

The alternating current on the trolley acts upon the telephone lines a great deal like the passing cloud acts upon the transmission line. As the pressure rises from zero to maximum, positive in value, it induces upon the telephone wires a bound negative charge and a free positive charge, which may be presumed to escape easily, as leakage is a line virtue. As the positive pressure falls to zero, the negative bound charge is set free, and it escapes. From this reasoning, it seems that a leaky line is advantageous. The only danger then would be a sudden cessation of the trolley pressure, in which case the bound charge would be so suddenly set free that it would exceed the leakage flow, thereby assume a high potential and break through the insulation to ground, and render the telephone line noisy upon the introduction of pressure again.

As the potential of the alternating system is assumed to rise from zero to 2,000 volts each alternation, the static potential of the telephone line would tend to vary from zero to 2,000 volts also, if the insulation was perfect. But if the insulation is absolutely perfect the free positive charge would virtually be a bound one and would be neutralized by the negative charge being set free, hence no static potential could exist. No static potential can exist when the wires have no insulation. As the perfect condition is not possible, and the other condition not commercial, we might consider the present ideal line possibly half way between the two extremes.

The wave of an alternator reveals a most rapid rise and fall of pressure between certain limits, say, from zero to 1,000 volts. This would mean that the telephone lines would be subjected to a sudden change from zero to 1,000 volts, which we may assume is so swift that the leakage of our ideal line can not dissipate the charges that are alternately freed quickly enough to prevent the growth of a potential which might rise as high as 1,000 volts, and tend to strain the line insulation.

Distributed leakage is like a bridge set on piles, which can carry certain loads safely. Suppose a test made. Each time of crossing, the load is increased. The weakest pile will give away first, and we can be reasonably sure that no bridge could be built with piles absolutely equal in strength, nor could a chain be forged in which a heavy pull would break all the links at once instead of one link, the weakest one. The transmission line or the telephone line is subject to the same conditions. The telephone line now carries its load, and meets all requirements. But when subjected to a static strain, tending to rise to 1,000 volts value, the weakest part of the line will break down first, if within the limits of 1,000 volts, and it is safe to say that the insulation will break somewhere before the strain reaches 500 volts. The resulting noise will make the lines inoperative.

Suppose 10,000 volts on the trolley wire. According to the reasoning, the telephone lines might be subjected to 5,000 volts, if the leakage permitted it. The question is, will the parts of the line stand anywhere near 5,000 volts of strain? The toll line is only separated from the common battery ground by a repeating coil and a pair of condensers. We know that a condenser will rarely stand a pressure of 500 volts, and that a repeating coil will not stand much more. The present carbon arrester, with its intervening mica or piece of silk cloth, will break down when subjected to 500 volts strain. In house wiring, particularly for local battery work, annunciator wire, held by cleats, is used. It is not hard to imagine that such a line when connected to a toll line subjected to maximum strain of 5,000 volts would break down before 1,000 volts were reached. On the other hand, if the house wiring were perfect and connected to toll lines, our ideal line, a static potential would exist, which would be dangerous to some telephone users. If the insulation is poor, safety at the expense of noisy transmission is attained. Neither condition is desirable. How can a happy medium be attained?

That a grounded alternating condition of fairly high tension will work to the disadvantage of telephone lines has been known for a long time. When the New York Telephone Company was deciding to use common battery, it made every possible test on the western common battery exchanges, which the less cautious western companies had considered foolish, possibly. Among the tests made was one to see if a high-tension alternating grounded condition would prove disastrous to the operation of the common-battery system. To get this condition, it grounded one of the legs of the three-phase 11,000-volt power system at Minneapolis, Minn., which furnishes alternating current to the rotaries of the twin cities. No disturbance was noticed, nor at any future time when the grounding was accidental.

Mr. Paul Lincoln has described the effects of grounding one of the legs of a three-phase system (American Institute of Electrical Engineers, March, 1903): "the potential that a pair of wires tends to assume from static induction of power wires is that of the neutral point of the system. As long as conditions are normal, all three legs well insulated, the neutral point is at earth potential." The three wires act on a pair of telephone wires just like a well balanced, well insulated and well transposed metallic light or power line would act on a paralleling telephone line. Its external inductive effects are neutralized, and a grounded line could be run in parallel with it without disturbance. But "when a leak occurs, such as a broken insulator, the neutral point shifts in value, rising above earth potential. If the leak at the insulator becomes a dead ground, the neutral point of the system rises to a value, which is fifty-eight per cent of the total voltage of the system." Grounding one of the legs of the 11,000-volt system at Minneapolis would make its neutral point attain a value of 6,500 volts above ground, and the paralleling telephone lines would tend to assume the same value. Mr. Lincoln, furthermore, adds that in practice a great majority of railway telephone lines are broken down and rendered inoperative when such a grounding accident happens and telephone service is needed most.

In East St. Louis there is a three-phase power system serving an extensive motor load at 2,400 volts. Last summer, during a storm, one of the service wires leading to a deserted building was burned off, and fell into a pool of water. It was noticed by the telephone people of both Bell and Kinloch companies that their lines in this neighborhood became noisy during that storm, and, of course, thought the trouble would clear when the moisture dried up But the trouble did not disappear that easily, and the power company was not aware of any trouble, either to itself

or to others. When the fallen wire was cut off the noisy lines became instantly quiet. Now these lines were of best modern construction, and they parallel the direct-current trolley line for miles. A condition of quiet indicated the best conditions of balance and insulation, apparently, obtainable. Yet they were rendered noisy by the alternating conditions. With a good ground and a total voltage of 2,400, the voltage of the neutral point rose to practically 1,400 volts, which induced a static potential sufficient to break down the insulation of every telephone line in its neighborhood.

The power wires at Minneapolis were laid underground, and no disturbance has ever been felt from accidental grounding at 6,500 volts neutral potential. The St. Louis system, with one-fourth of the value of the neutral potential, easily made the telephone system inoperative. This system is overhead, and the same height of the telephone wires, practically. This leads to a suggestion of a remedy with which to render the grounded alternating trolley system harmless in its effects upon neighboring telephone leads. If the trolley wire were underground in conduit or third rail on the ground no inductive potential could be effective on the telephone lines, either overhead or underground. With such high tension the third rail is impossible, and likewise the conduit system. The railways are going to build in their own aggressive way, and the courts will uphold them as long as there is an available remedy known to science. The telephone company will have to care for its trouble.

If a ground wire or network of wires, three or four, put at top, bottom and at two sides of the telephone lead, could be run along the lead and well grounded at short intervals, the lead would be put at earth potential, which would not only protect it from static strains from the trolley wire, but from lightning itself, that is, induced effects of lightning. Such a system of protection would not be expensive, and would preclude the necessity of reinsulating all lines and apparatus on a high-tension basis.

Time did not permit a test at St. Louis with a ground wire shield, and consequently a verification of the remedy suggested could not be made. In a short time the electrical department of Purdue University will be in possession of a 1,000,000-volt transformer, and tests will be made upon metallic lines of different grades of insulation with all inducing pressures from zero to 1,000,000 volts, which is the highest practice in high-tension practice so far.

Possibly the danger is overdrawn. Let us hope that it is.

Electric Smelting Furnaces.

At a recent meeting of the Philadelphia section of the American Electrochemical Society, the papers upon the electric smelting of iron ores which had been read at the International Electrical Congress were taken up for discussion. In this connection some recent improvements in the Gin furnace were described. The furnace is built with a main body in which the steel is treated. Below this is a compartment built in the form of a winding channel, with walls of very refractory material. This channel is connected in series with four treating basins, and in two of these the electrical connections are made. These connections are water-jacketed to prevent them from melting. A continuous flow of metal takes place from the charging ports to the treating basins. On account of the electrical resistance of the canals, the temperature is brought up to 1,900 degrees centigrade, the temperature in the upper basins being 1,600 degrees centigrade. The furnace absorbs 7,200 kilowatts, utilizing a current of 60,000 amperes at 120 volts. The output is 350 tons of steel in twenty-four hours.

After the meeting a communication to the discussion was received from Mr. N. Lilienberg, upon the economy of electric smelting. It is out of the question to supply the electricity required by means of dynamos driven through steam engines, since in the production of steam the amount of heat lost in the chimney corresponds to that lost in the regenerative steel furnace or in a blast furnace, and there would be, in addition, all the losses in the engine and dynamo, and the expense of the installation. The case is somewhat different when water power is available and coal is high, but water-power developments are very costly. The capital required becomes a serious item. It hardly seems possible for the electric furnace to compete with the blast furnace, if the ore must be pulverized and made up into briquettes with coal, even should wrought iron be obtained directly.

The higher temperature available in the electric furnace makes it possible to use more lime and magnesia, and less silica, whereby the amount of phosphorus in the product is reduced. About the same result is obtained in an ordinary open-hearth basic furnace, if of large size.

As the electrodes in the electric furnace do not dip into the molten steel, but only into the slag, there is a tendency for the current to pass along the upper surface, superheating the slag. This suggests the advisability of making such crucibles of large diameter and of limited depth.

A recent type of furnace invented by Gin aims to force the current through the steel, instead of across the surface. For this purpose the bottom of the furnace is made of cast iron, cooled by water, and the electrical connections are made of the iron. This construction introduces a danger of cracking the cast-iron bottoms, due to unequal heating. Should this take place, and the water come in contact with the melted steel, the furnace would probably blow up.

A written communication was received from Mr. Daniel Baker, who called attention to the fact that the increased temperature obtainable in the electric furnace permitted the use of a very basic slag. He said that the increased basicity of the slag is not valuable unless, at the same time, the temperature is high enough to maintain it at a good working fluidity. It seems to Mr. Baker that the proper field for the electric furnace in the iron business lies, not in the manufacture of steel from pig, but in an operation where the blast-furnace process is omitted, particularly in cases where it is not permissible—for instance, in the smelting of titaniferous ores. These ores are frequently low in phosphorus, sulphur and silica, and high in titanic acid, and so far have been rejected in blast-furnace treatment. It seems to him that the large deposits of this ore on the island of Newfoundland might be profitably worked by this process, as there is also on the island an abundance of water power and practically no coal.

City of Newark to Attempt to Collect Taxes from Public Service Corporation.

The city of Newark, N. J., has deputized City Counsel Joseph Coult to take the necessary steps to secure payment from the Public Service Corporation of an amount equivalent to five per cent of the annual gross earnings of the trolley lines in the annexed section of the city for the fiscal years ending April 30, 1903, and April 30, 1904. By the annexation of Clinton township to Newark, about ten miles of track were added to the mileage of the Public Service Corporation in Newark. This trackage is subject to the provisions of the contract made in 1890 between the city and the street car companies which have since been absorbed by the Public Service Corporation. Among the provisions of this contract is one fixing a payment to the city of five per cent of the gross receipts of all the lines within the city limits. The amount immediately involved is about $3,500.

Reviews of Current Engineering and Scientific Literature.

The Efficiency of Direct-Current Driving.

While direct-current systems may not be suitable for long railways it is generally supposed that for short, busy lines in towns or suburbs it leaves very little to be desired, so far as economy or energy is concerned. It seems to Mr. W. M. Mordey worth while examining the evidence on this subject obtained from practical working. While there may be more important things than efficiency—reliability and regularity for instance—it is interesting to examine the actual conditions of a road in operation and to see whether the energy efficiency there obtained is approximately what it is assumed to be. The Liverpool Overhead Railway furnishes an excellent opportunity of investigating this subject, for there is not only a large amount of data collected from actual operation, but some valuable tests were made recently on this road which is not in any way unusual, and which possesses many admirable qualities. On this road a recent improvement has been made in the service by increasing the acceleration of the trains, resulting in a reduction of the time for the entire journey—six and one-half miles—from 32 to 20.4 minutes, the average being increased from twelve and one-half to nineteen miles per hour. The intermediate stops were eleven seconds each. The tests made on this road were conducted with a train consisting of two motor coaches and one trailer. It was fitted with four 100-horse-power motors. The seating capacity was 154 passengers. The train, fully loaded, weighed fifty-six tons. When the tests were made the weight was 46.3 tons. A speed-time curve of one run is given, an examination of which shows that, during the run, 9,400 kilowatt-seconds or 2.61 kilowatt-hours were consumed. Assuming the traction coefficient to be fifteen pounds to the ton as an average—and it could hardly be more—the useful energy spent in driving the train over the entire distance of the run, which was 2,110 feet, is found to be 0.55 kilowatt-hour. This would make the overall locomotive efficiency for the complete journey twenty-one per cent. If the energy required to accelerate the train is considered useful the efficiency is found to be seventy-one per cent; but the author does not think that this is the proper way to look at the problem, because it is conceivable that a satisfactory regenerative method may be developed which will save much of the energy used in accelerating. If the brakes were not applied to the train it would run for nearly 5,000 feet instead of stopping within the 200 as was actually the case. Summing up the energy account of this train it is found that twenty-one per cent of the energy consumed is useful work in moving the train, fifty per cent is lost in braking, eleven per cent in motor losses, and eighteen per cent in starting resistances and other losses. The principal lesson to be learned from this is that on all short lines a regenerative method should be used instead of friction brakes. The results just quoted were obtained by an experimental train which showed a consumption of six and one-half kilowatt-hours per train-mile. From the working results of the railway for the last six months of 1903 the consumption per train-mile was only 6.09 kilowatt-hours. The difference may possibly be due to the trains in regular service being lighter than the test train.—*Abstracted from the Electrical Magazine (London), November.*

The Works of Bruce Peebles & Company, at East Pilton, Edinburgh, Scotland.

The business of Bruce Peebles & Company had increased to such an extent in 1903 that it was found necessary to leave the old Tay works, at Leith, and new ones were, in consequence, erected at East Pilton, near Edinburgh. The site adjoins the Leith branch of the Caledonian railway, and has thus easy access to the railways of the country and to the docks at Glasgow and Leith. The buildings existing at present consist of a three-story office structure and a main machine shop 600 feet long and 160 feet wide. The main building is divided into three aisles with galleries over the outer two. Each aisle is served with electric cranes and there are a number of two-ton jib cranes at various points for handling the work, leaving the traveling cranes free to transport material. Electric driving has been adopted throughout. This method, in addition to its being convenient, furnishes the customers with a valuable object lesson. The power station contains two main operating units, one driven by a high-speed, compound, condensing steam engine, and the other by a gas engine. Power is distributed to the three-wire system at 230 and 460 volts, the machine motors being connected across the outers. The gases from the producers are passed through a boiler which supplies enough steam for the needs of the plant itself. The gas is used also in the annealing and drying-out ovens. The different divisions of work are arranged in the shop so that the material progresses regularly from end to end. The shop is equipped with all the usual machines, tools and lathes. There are, in addition, a number of special tools. One of these is for forming edge-wound copper-strip field coils. When this strip has a rectangular shape, bending makes the inner portion of the strip thicker than the outer, giving an undesirable loose appearance to the finished coil. The strip used by Bruce Peebles & Company is thinner on the inner edge so that the cross-section becomes truly rectangular after it has been bent. The insulating material is thus gripped equally at the inner and outer edges of the coil. The spirals, after being wound, have a slight cut taken off, giving the coil a pleasing appearance. Machines of all types, from small motors up to 1,500-kilowatt turbo-generators, are manufactured.—*Abstracted from the Electrical Engineer (London), November 25.*

A Protest on Behalf of Wattless Current.

A vigorous protest is made here against the misleading terms, "wattless current" and "wattless power." Mr. E. J. Willis takes the sensible stand that there is no need to consider an alternating current as consisting of two components differing in phase by ninety degrees, the one of these being the power component which does the work, and the other being wattless or idle and producing no useful effect. He explains the usual methods of treating alternating-current problems, expressing preference for the Zeuner or Steinmetz diagram, since this is easily laid out with a pair of compasses and it represents all the conditions of a complete cycle. From these figures he shows how the term "angle of lag" has come into use, and the significance of the cosine of this angle usually termed the power-factor. He contends, however, that this should be considered rather as a time factor, indicating merely that the

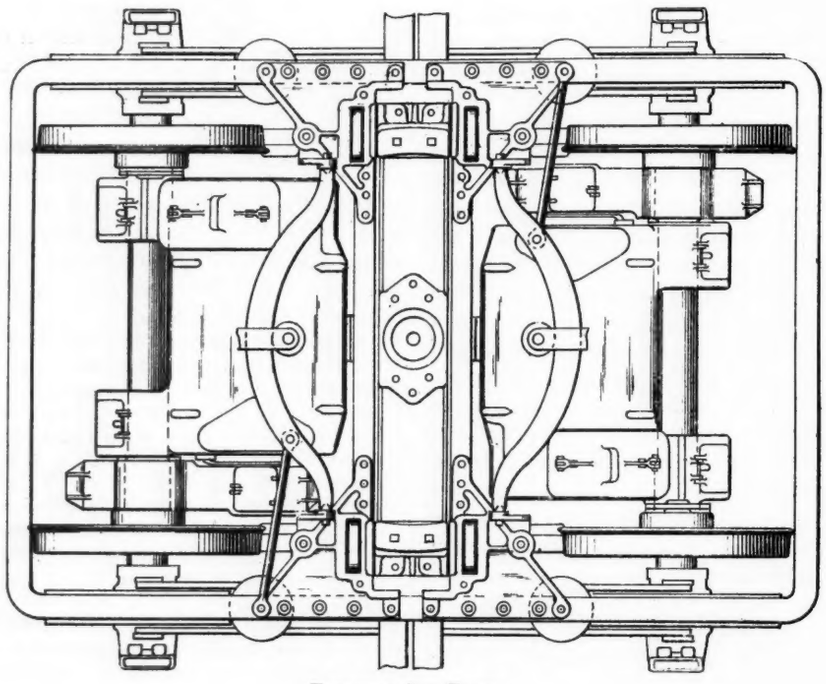
current and the electromotive-force waves are not in phase and not that a certain portion of the current is idle. In fact, this current is not idle at all, since during every half-cycle it does an amount of work represented by multiplying it with the voltage, but during the next half-cycle it undoes this work. Thus, while the average value of the work done by this component of the current is zero, it actually represents work during each half-cycle. In fact, if instantaneous values are considered instead of the effective values as indicated by the alternating-current instruments, the true power is given strictly by the product of current and voltage. Mr. Willis believes that if the student is taught to think more in terms of instantaneous values and to use the effective values only as a convenient means of obtaining the average work done, much of the difficulty met in obtaining a clear idea of alternating-current work will disappear. The fact that Ohm's law is always applicable, if instantaneous values are considered, should be impressed upon the student. It should be shown that this is applicable to direct-current readings only when the current is so steady that the average value is, to all purposes, equal to the instantaneous value; and in alternating currents, if instantaneous values are considered, the law equally holds.—*Abstracted from the Stevens Institue Indicator (Hoboken, N. J.), October.*

Electrical Installations Driven by Windmills.

For some years past the Danish government has been conducting experiments on the production of electricity by means of windmills. The work has been carried out by M. P. La Cour, of the Academy of Ascov, and his results are described by Dr. Alfred Gradenwitz. Work was first begun in 1891 with a small windmill, but in 1897 a larger driving wheel was built and a controlling apparatus developed which has given satisfaction during two years' operation. The wings of the mill are 11.4 metres long, and are mounted so that they automatically present the front to the wind. The angle of the wings varies with the velocity of the wind. This wheel drives a dynamo through gearing and belts, and the latter is controlled so as to charge a storage battery with an approximately constant current. The connection of the dynamo to the batteries is controlled automatically by means of two electromagnets connected in shunt across the machine. The poles of the magnets are opposed to each other, and in the gap between them is pivoted a permanent magnet arranged to rock backward and forward. To this magnet is attached a copper rod in a horizontal position, the ends turned down so as to dip into vessels containing mercury when the permanent magnet rocks in one direction, and to open the circuit when it is thrown in the reverse direction. Assuming the voltage of the dynamo to be below normal, and to be increasing, a point is reached when the attraction and repulsion between the two sets of electromagnets throws the rocking magnets over, and thereby closes the charging circuit. The charging current then passes through two series coils placed on the magnets. The object of these is to open the charging circuit should the batteries begin to discharge through the dynamo. This device is quite simple in construction, and has proved entirely satisfactory in its operation. To maintain the charging current constant, the dynamo is driven through a countershaft; the latter is driven by a vertical belt. This countershaft is mounted on swinging arms, and a belt is led off horizontally to the dynamo. By this arrangement the tension on the vertical belt can be regulated so that the driving torque will not exceed a certain value. By this simple arrangement the speed of the generator is varied independently of the speed of the windmill and of the voltage of the batteries, so as to deliver a nearly constant charging current. Tests have shown that this charging current will vary only one ampere in forty when the voltage of the generator varies from 110 to 160, while the speed of the dynamo varies from 837 to 1,060 revolutions per minute. Since the power delivered to the dynamo is proportional to its speed and to the resisting torque, the watts delivered are nearly proportional to the speed at which it is driven. This ratio is found to hold closely in practice. The question of controlling the generator having been solved in this way, a study of windmills has been carried out, giving some interesting and unexpected results. It has been found that a plane wing will develop only one-half as much power as one which is curved. The maximum power obtainable with a plane wing is only forty-two gramme-metres per second per square metre of surface, with a wind velocity of one metre per second. This maximum is obtained if the speed of the wing is 2.33 times that of the wind, and the angle of the wing is 12.5 degrees. On the other hand, a wing with a broken or curved surface may develop a maximum of 108 gramme-metres per second, the velocity of the wing being three times that of the wind, and its angle 7.5 degrees. As one cubic metre of air at a speed of one metre per second represents a quantity of energy of 64.5 gramme-metres, it is surprising that a wing with a surface area of one square metre is able to develop 108 gramme-metres per second. If a wing having this same area were pushed in the direction of the wind, it would be able to develop only 11.1 gramme-metres with a speed of thirty-three centimetres per second. M. La Cour believes that the fact that the grooved wing will develop more power may be explained by the reactions set up when the wing is in motion. There is a partial vacuum produced behind it, and it utilizes more of the wind than is represented by its surface. M. La Cour has developed certain principles governing the construction of windmills for the greatest effect. It is convenient to employ four wings, of which the width shall be equal to one-fourth or one-fifth of the length and constant throughout their total length. The surface of the wing should commence at a distance from the axis equivalent to the width of the wing. The cross-section of the wing should be curved or broken so that the greatest part will be about three times wider than the other, and placed in front. The distance between the cord of the arc and the summit of the angle is from three to four per cent of the width of the wing. A straight line connecting the extremities of the wings, front and rear, should form an angle of ten degrees in the direction of movement of the wing, this angle increasing continually toward the centre until it takes a value of twenty-five degrees. The speed of the extreme tip of the wing should be 2.43 times that of the wind when developing maximum work. These conditions being satisfactory, the quantity of work furnished by a mill will be sixty gramme-metres per square metre of wing surface for a wind having a velocity of one metre per second, and it increases as the cube of the speed of the wind. The experimental windmill has been furnishing electrical energy to the inhabitants of the neighborhood, the normal load being sixty amperes at 220 volts. An oil engine has been installed in the mill as a reserve. The cost of this installation is 16,000 crowns ($4,300), 3,000 crowns ($800) having been expended for the oil motor. Energy is furnished to consumers at five cents per kilowatt-hour for motive power, and at 18.7 cents per kilowatt-hour for lighting, the receipts being about $780 per year, and the expenses $215. The installation is practically self-operating and requires no attention whatever during the day. The attendant may even leave the building.—*Translated and abstracted from L'Electricien (Paris), November 26.*

Electrical Patents.

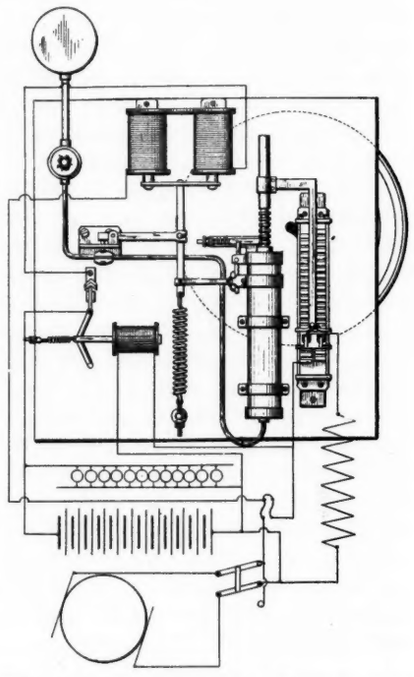
A patent (776,303, November 29) on an electric car truck has recently been granted to William Dalton, of Schenectady, N. Y., and he has assigned his patent to American Locomotive Company, of the same place. The object of the invention is to so construct and combine the foundation-brake rigging with the truck of a car as to prevent the imposition of side strain upon the former when the truck is on a curve and to enable the brakes to be operated by either hand or power mechanism, as desired, through separate systems of rods, so that the disabling of one system will not prevent the operation of the other. The invention consists of a car frame having two motor trucks fitted to swivel relatively thereto. Brake shoes are suspended from the truck frames in position to be applied to the wheels of the truck axles, brake levers being coupled to these brake shoes. Transverse connecting members are coupled to the brake levers of a pair of wheels. Means are employed for maintaining the transverse connecting members in normal relation to the frames during the swiveling movement of the trucks, and to the transverse connecting members is coupled a power-brake mechanism. Hand-brake mechanism is located at each end of the car and coupled to the transverse members of the adjacent outer truck axles, and connections are provided for coupling the hand-brake mechanism for simultaneous operation from either end of the car.



ELECTRIC CAR TRUCK.

Achille Meygret, of Paris, France, has patented (776,192, November 29) in this country a protective coating or covering for storage-battery plates. The object of the present invention is to furnish a protective coating or covering to overlie the active material on the grid and retain such material on the grid against the effects of expansion and contraction of the active material by which the material becomes loosened and falls or detaches itself from the grid and without increasing the weight of the plate as a whole, or decreasing the active surface in connection with a thin plate and in no wise militating against the activity of the plate as a whole. The protective coating or covering is a solution of tetra-acetate of cellulose or a solution of tetra-acetate of cellulose and tetrabutyrat of cellulose, either of which solutions can be used to make the protective coating or covering. The plates or electrodes of a battery can be of any usual construction, consisting of a grid and a filling of active material applied to the grid. The plate after the filling of active material has been applied thereto is to be dipped in the solution either of tetra-acetate of cellulose or the solution of tetra-acetate of cellulose and tetrabutyrat of cellulose for the solution to adhere to and form a coating or covering over the active material. This protective coating or covering forms in effect a sheath or film enclosing within it the active material, holding the material to the grid against the effects of expansion and contraction of the active material in charging and discharging the plate.

Isidor Deutsch, of Montreal, Canada, has assigned to the Electric and Train Lighting Syndicate, Limited, a patent (776,223, November 29) recently granted to him on means of controlling the voltage from electric generators. The invention relates to improvements in means for controlling the voltage from an electric generator, particularly generators subject to sudden variations in speed, and the object of the invention is to cheapen the construction of such devices and to provide a noiseless mechanism which shall be positive as a regulator in its operation at a minimum expenditure of electric energy. The invention consists, essentially, of a dynamo, a rheostat in the shunt-field circuit of said dynamo, a cylinder and piston operating therein, having a rod preferably provided with annular grooves, a connecting arm from the piston-rod to the contacts having connection with the rheostat, a solenoid, and suitable admission and exhaust valves and arms for the cylinder, the various parts being constructed and arranged in details.



MEANS FOR CONTROLLING THE VOLTAGE FROM ELECTRIC GENERATORS.

A few weeks ago an Otis electric elevator was shipped from Yonkers, N. Y., to the grand cathedral at Berlin, Germany, for the exclusive use of the Emperor.

SOME REFINEMENTS OF MECHANICAL SCIENCE.[1]

BY AMBROSE SWASEY.

For the subject of my address, I wish to speak of a few of those methods and mechanisms which have been developed and perfected to such a degree of refinement that they may be considered as almost beyond the practical, and yet were it not for such refinements they could not possibly be made to serve the utilitarian purposes which make them of such inestimable value to us all.

The division and the measurement of time is to-day, as it has been for ages, among the most important of the subjects affecting the welfare of mankind, and as time has rolled on and there has been a better understanding of the laws governing the universe, nearer and nearer has been the approach to perfection in the working out of these difficult problems, but the many limitations surrounding them have always kept their full solution somewhere in the future.

The diurnal revolution of the earth, which gives the solar day, and the revolution of the earth around the sun, the solar year, are the arbitrary divisions of time marked off with the utmost precision by the celestial bodies; and while the length of the solar day has, from before the Christian Era, been fairly well defined, the length of the solar year was but approximately known until within a few hundred years.

The length of the year as counted by the Julian calendar was too long by eleven minutes and fourteen seconds, and this error amounted to ten full days in the sixteen hundred years from the time the Julian calendar went into effect until the introduction of the Gregorian calendar.

A few years ago when visiting the Vatican Observatory, I was particularly interested in the Gregorian tower, which forms a part of the Vatican Library Building. After passing through a number of rooms which are used in connection with the observatory, when near the top of the tower I was taken into the spacious and beautiful calendar room, the walls of which are covered with paintings of the highest order, executed centuries ago, under the direction of Pope Gregory XIII. In the centre of the room, and forming a part of the floor, there was a large marble slab, on which was cut a fine line exactly in the true meridian, and upon the line was a special mark which indicated the altitude of the sun at noon of a certain day. On the south wall, near the top of the room, there was a small aperture through which the direct rays of the sun passed at noon, projecting a bright spot on the meridian line.

All of this had been planned and executed by the astronomers in order that they might demonstrate the necessity of reforming the calendar, and when at noon on March 23, 1582, Pope Gregory saw that the altitude of the sun as shown by the beam of light was not for that particular day, but for the day ten days previous, he directed that ten days be stricken from the calendar, and that day should be March 11 instead of March 23.

With such precision had the astronomers determined the true length of the year, that our present calendar with its intercalations will continue on for twenty thousand years, with an error not to exceed a single day.

The line on the marble slab and the aperture through the wall of the calendar room were devices simple in the extreme, and in this day of instruments such a method would hardly be considered, yet they served their purposes admirably, and the placing of that line on the true meridian, with an accuracy never before attained, was considered one of the greatest scientific achievements of that age.

The sun-dial is not only the earliest, but the most interesting of all the numerous arrangements that have been devised for measuring the divisions of the day. Notwithstanding its limitations, it has been a subject which has attracted the brightest minds for ages. Recently a new dial has been invented, by which the rays of the sun will indicate the true mean time for each day of the year, with an error not to exceed one minute.

The hour-glass, which came later, was considered a much more practical method, inasmuch as it could be used either day or night, and because its use was not confined to a particular location; however, as a timekeeper it was not satisfactory, even in those early days.

The clepsydra or water-clock, which is supposed to have been invented by the Greeks, was found to be a much better timekeeper than either the sun-dial or hour-glass, and it was a great step in advance toward the accurate measurement of time.

These water-clocks are to this day used extensively in the East, more especially in China. In the city of Canton there is a water-clock which has been running for eight hundred years, and at the present time it is the standard clock of that city.

This clock consists of four water-jars, each having a capacity of eight or ten gallons. The jars are placed one above the other in the form of a terrace, the three upper ones being provided with a small orifice near the bottom through which the water drops into the jar next below, and so on down from one to the other until the water reaches the lowest or registering jar. In this there is a float to which is attached an upright having graduations for the hours and parts of hours, and as the water rises the time can be determined by noting the height of the float in relation to the cross-bar at the top of the jar.

In this improved form of water-clock the variation in the flow of water due to the difference in height is overcome by having a series of jars, the outlet of the upper being so graduated that there is but little variation in the height of water in the second jar, and in the third the height remains practically uniform, thus ensuring a constant head for the water which drops into the registering jar. At the beginning of each day the water is taken from below and carried up a flight of steps to the top.

That such an arrangement has some elements favorable to the accurate measurements of time, there can be no doubt. It certainly has the element of simplicity, and notwithstanding its long service the only wear noticeable was confined to the steps leading to the upper jar.

Clocks of the present type, although used as far back as the twelfth century and possibly earlier, were but fair timekeepers until several centuries later. Those which the astronomers used in their observatories at the end of the fifteenth century were so unreliable that modified forms of the clepsydras of the ancients were used, and as they did not prove to be satisfactory most of the observations were made without the use of clocks.

Galileo's beautiful discovery of the isochronism of the pendulum from the swinging chandelier in the church at Pisa was of great value in many respects, but in none more so that in its application to the measurement of time.

Soon after the great discovery the English clock-maker, Graham, invented the mercurial pendulum, by which the variation in its length caused by the difference in temperature was fully compensated, and some years later Harrison, another English clock-maker, invented a compensating pendulum, which consisted of a series of metal bars having different coefficients of expansion—so that two

[1] Abstract of the president's address at the New York meeting, December, 1904, of the American Society of Mechanical Engineers.

hundred years ago, as it is to-day, the pendulum was the nearest perfect of all the devices that have been employed for governing or controlling the motions of a clock mechanism.

Every part of the clock down to the minutest detail has been the subject of study and improvement, and they are made and adjusted with such precision and delicacy that in testing them the question is within how small a fraction of a second will they run. Not content with their marvelous performance when under normal conditions some of the finest astronomical clocks are surrounded by glass or metal cases in which a partial vacuum is maintained, and in order that the cases may not be opened or disturbed the winding is done automatically by means of electricity; the frequency of the winding in some cases being as often as once every minute. These clocks are set up in especially constructed rooms or underground vaults where they are free from jar or vibration, where the temperature and barometric conditions remain practically constant, and where every possible precaution is taken to further minimize the errors of the running rate.

A clock in the observatory at Berlin has run for several months under these favorable conditions, with a rate having a mean error of but fifteen one-thousandths of a second per day and a maximum error of thirty one-thousandths of a second per day.

From the time of the invention of Peter Hele, in 1477, of the "Nuremburg animated egg" or "pocket-clock," which required winding twice a day, and varied an hour and one-half in the same length of time, the development of the watch has kept pace with the "mother clock," and followed closely to it in timekeeping qualities.

The larger watch or ship chronometer, with its escapement so delicately made and adjusted that it must always be kept in the same position, was greatly improved through the efforts of the British government in 1714 by offering rewards of ten, fifteen and twenty thousand pounds to any who should make chronometers that would run so accurately that the longitude of a ship at sea could be determined within sixty, forty and thirty miles, and Harrison, the inventor of the compensating pendulum and the compensating balance, which is now used in watches, succeeded in making a chronometer, which, after being tested on a long voyage, was found to run so closely that the position of the ship was determined within eighteen miles, and he was therefore paid the full award of twenty thousand pounds. That historic chronometer, which marked a new era in navigation, is now numbered among the treasures of the Greenwich Observatory. Modern ships are equipped with chronometers so accurate and so reliable, and with sextants of such precision that navigators can determine their position in latitude and longitude within a few miles.

The perfection attained in the measurement of time, which is of such great practical value in nearly every sphere of life, would not have been possible were it not for the even greater refinements that have characterized the methods and instruments used by the astronomer in determining the length of the day and of the year, which are the fundamental standards of time.

The division of the circle and the measurement of angles has ever been among the unsolved problems of the astronomer, yet in the instruments used by him circles have formed a most important part. Long before the telescope was invented Tycho Brahe, the Danish astronomer, "the founder of modern astronomy," constructed for his observatory instruments of various kinds having graduated circles and arcs of circles. His instruments for the most part were improvements on those used by Arabian astronomers in the eighth and ninth centuries, and these, in turn, were copied after similar instruments used by the Greeks and Egyptians a thousand years previous, and it is supposed that such instruments were used by the Chinese at an even earlier period, so that graduated circles have come down to use from the far-off ages.

The longer the radius the more accurate the graduations was the principle upon which the early instruments were made. The Arabians, in about the year 1000, built a sextant with a sixty-foot radius and a quadrant with a twenty-one-foot radius, but to Tycho Brahe is due the credit of constructing instruments having circles, much smaller in diameter and graduated with a greater precision than ever before. It was by the use of such improved instruments of his own making, and by his own observations which were made without a telescope or any means of magnification, that he was able to give the positions of a large number of stars within less than one minute of arc from the positions given by modern astronomers.

The graduation of an eight-foot mural circle in 1725 by Graham, of England, for the National Observatory, and of an eight-foot quadrant by Bird in 1767 were notable steps in advance in the division of the circle and the measurement of angles.

The first circular dividing engine was made in 1740 by Henry Hindley, of New York, for cutting the teeth of clock-wheels, and it is interesting to note that in the same year Huntsman, another clock-maker, of Sheffield, invented the process of making crucible steel, that he might have a metal suitable for the springs of his clocks.

Of the several engines constructed later the one most successful and representing the greatest progress was that made by Ramsden in 1777. This engine, automatic in its movements, was made especially for graduating circles, and because of the great precision with which he divided the circles of the instruments used by the Government the Board of Longitude awarded him the sum of six hundred and fifteen pounds. A further and most potent recognition of the excellence of his work lies in the fact that all subsequent circular dividing engines have followed closely the same general principles of construction embodied in the Ramsden engine.

Many excellent dividing engines have been made that are quite sufficient in point of accuracy for the work for which they were intended, but the perfection required in the graduation of circles for astronomical instruments is such that it has been found to be one of the most difficult of all mechanical problems to make an engine that will meet such requirements. In such an engine the chief essential is that the spindle carrying the master-plate shall be as nearly round and as closely fitted in its bearings as is possible, for the degree of excellence with which that work is done determines how closely a circle can be divided.

It seems almost incredible that a well lubricated spindle of four inches in diameter at its largest part and tapering three-quarters of an inch to the foot can be made so nearly round and so closely fitted in its bearings that a movement of one-thousandth of an inch in or out of its bearings will in one case cause it to turn with difficulty, and in the other with perfect freedom, yet this has been found to be within the limits of mechanical refinements.

The greatest accuracy thus far attained in such engines is one second of arc, which arc, with a radius of three miles, equals one inch, and at twenty inches, which is the radius of the silver ring

upon which the graduations on the master-plate are made, a line one-thousandth of an inch in width is equal to twelve seconds of arc, or twelve times the accumulated errors of any number of divisions, or twenty times the greatest error of any single division.

In automatically graduating a circle, it has been found to be impracticable to cut more than six lines in a minute, and it requires about thirty-three hours to divide a circle into two-minute spaces. Instead of the large circles and sectors used by the ancients, they have been made smaller in diameter as the methods for graduating have been improved, until those of the more modern instruments are seldom more than thirty inches, and some of the latest meridian instruments have circles of but twenty-five inches. A twenty-five-inch circle read with a microscope having a power of forty would be equivalent to a circle of about eighty feet in diameter, and a single second of arc as seen through the microscope would be equal to 0.0024 of an inch, a quantity easily subdivided.

A most important adjunct to the astronomer's instrumental equipment is the filar micrometer. With it he determines the errors of divisions, the eccentricity of his circle and measures the angles to within a fraction of a second; and when used at the eye end of the telescope he determines the positions and motions of the stars and the distances and diameters of the planets. In these little instruments, whether of the simple or complex form, the chief requisites are the screw and the cross wires, for upon them the value of the observations and measurements depends.

To make the screw of a micrometer so true that the errors in the threads can not be detected by its own magnifying power is an extremely difficult task. These micrometer screws are often made with one hundred threads to the inch, and are provided with graduated drums having one hundred divisions, the readings being made in tenths of a division.

The cross wires, which are but common spider lines, because of their fineness and the remarkable qualities they possess, are indispensable in micrometric work.

That the repulsive and even dangerous spider has plenty of enemies among the human family there can be no doubt, yet if the value of the contributions which it has made to the cause of science were generally known, it would surely have a greater number of friends than at present, and most certainly the astronomer will say naught against it, for after the experience of many years he has found that the spider furnishes the only thread which can be successfully used in carrying on his work.

The spider lines mostly used are from one-fifth to one-seventh of a thousandth of an inch in diameter, and in addition to their strength and elasticity, they have the peculiar property of withstanding great changes of temperature, and often when measuring the sun spots although the heat is so intense as to crack the lenses of the micrometer eye-piece, yet the spider lines are not in the least injured.

The threads of the silkworm, although of great value as a commercial product, are so course and rough compared with the silk of the spider that they can not be used in such instruments.

Platinum wires are made sufficiently fine, and make most excellent cross wires for instruments where low magnifying powers are used, yet as the power increases they become rough and imperfect.

Spider lines, although of but a fraction of a thousandth of an inch in diameter, are made up of several thousands of microscopic streams of fluid, which unite and form a single line, and it is because of this that they remain true and round under the highest magnifying power.

An instance of the durability of the spider lines is found at the Allegheny Observatory, where the same set of lines in the micrometer of the transit instrument has been in use since 1859.

The placing of the spider lines in the micrometer is a work of great delicacy, and in some micrometers there are as many as thirty which form a reticule, with lines two one-thousandths of an inch apart, and parallel with each other, under the highest magnifying power.

Step by step from the methods of the Arabian astronomers to the time of Tycho Brahe and on down to the present day, improvements in the instruments and methods for the measurement of angles have been going on, until astronomers can measure double stars with a separation of one second of arc, and within less than one second they can define their positions in the heavens.

In the realm of the measurements of minute linear distances, and the perfection of curved and flat surfaces, the refinements are even greater than those pertaining to the measurement of time and of angles.

Most important in the linear dividing engine is the screw, and although much had been accomplished in bringing such engines to a high degree of excellence, it was for Professor Rowland to make an engine which has a practically perfect screw; and without doubt it is in all respects the nearest perfect of all the mechanisms that have been employed for ruling lines exactly parallel and equally spaced.

The Rowland engine was made especially for ruling diffraction gratings which are made of speculum metal, and with it a metal surface has been ruled with 160,000 lines, there being about 29,000 to the inch, and as many as 43,000 lines to the inch have been ruled.

The gratings mostly used have from 14,000 to 20,000 lines to the inch, and with such exactness is the cutting tool moved by the screw that the greatest error in the ruling does not exceed one-millionth of an inch.

The production of these gratings, which has enabled the physicist in his study of the spectrum to enter fields of research before unknown, has not only called for the highest degree of perfection ever attained in the spacing of linear distances, but it has also called for a refinement most difficult in the optical surfaces upon which the lines are ruled. To Mr. Brashear was given the problem of producing such surfaces, and notwithstanding the many difficulties encountered in working and refining the speculum metal plates, he has made many hundred plates with surfaces either flat or curved with an error not to exceed one-tenth of a wave-length of light, or one four-hundred-thousandth of an inch.

The established standards of length which are the yard of Great Britain and the metre of France, being made of metal, and liable to destruction or damage, Professor Michelson conceived the idea of determining the length of these standards in wave-lengths of light, which would be a basis of value unalterable and indestructible.

For the purpose of carrying out these experiments, the interferometer was constructed, an instrument which required the highest order of workmanship and the greatest skill of the optician. Again Mr. Brashear proved to be equal to the occasion, and made for the instrument a series of refracting plates, the surfaces of which were flat within one-twentieth of a wave-length of light, with sides parallel within one second. This was the most difficult work ever attempted in the refinement of optical surfaces.

Professors Michelson and Morley devised a method for using the interferometer for making the wave-length of some definite light an actual and practical

standard of length. So satisfactory was the result that Professor Michelson was invited to continue the experiments at the bureau of weights and measures, at Sèvres, France, where the standard meter, which is kept in an underground vault and inspected only at long intervals, was used for that important work, which occupied nearly a year. The final result of the experiments shows that there are 1,553,164.5 wave-lengths of red cadmium light in the French standard metre, at fifteen degrees centigrade. So great is the accuracy of these experiments, that they can be repeated within one part in two millions. Should the material standard of length be damaged or destroyed, the standard wave-length of light will remain unaltered, as a basis from which an exact duplicate of the original standard can be made. These two marvelous instruments, the Rowland dividing engine and the Michelson interferometer, show tl e possibilities in the perfection of linear divisions and the standards of length.

We have recounted some steps of the progress that has been made in the measurement of time, of angles, and of length, together with some of the refinements in these measurements, but we are confronted with the fact that notwithstanding all that has been accomplished from centuries past down to the present time, that as ever before, there are many imperfections requiring new problems in mechanical science to be worked out for the further enlightenment and welfare of mankind.

American Society of Mechanical Engineers.

The fiftieth meeting of the American Society of Mechanical Engineers was held in New York, December 6 to 9. The attendance was good, although not up to the usual figure, there being about 700 present at the meetings. Of the papers read, there was none of particular value to electrical engineers, though several of them bring out points of some interest.

The paper by Mr. A. J. Bowie, Jr., on "Centrifugal Fans," may be mentioned, as electric driving is being used very generally for fans and pumps of this type, and small centrifugal pumps are coming into use as feed pumps in boiler plants.

A paper entitled "Condensers for Steam Turbines" was read by Mr. George I. Rockwood. This is a condenser of the injector type, and, in use, it was found to give vacua of twenty-eight, twenty-eight and one-half and even twenty-nine inches. To obtain these high vacua very great care is necessary in the installation of the piping. During the discussion Mr. Rockwood said that he was surprised to find, in a number of condensing plants operating in connection with steam turbines, that the vacua under normal running conditions were considerably less than those mentioned, although to obtain the best economy of operation with steam turbines high vacua are necessary.

Mr. E. A. Hitchcock read a paper entitled "Road Tests of Brooks's Passenger Locomotives." He described some runs made in actual service with one of these locomotives. The figures showing the economy of the locomotive under these conditions are surprising. It was found that the furnace and boiler evaporated ten pounds of water per pound of fuel, and that the consumption of steam was about twenty-nine pounds per indicated horse-power-hour, a performance which would be considered good in a stationary plant of equivalent output.

Mr. Francis W. Dean, under the title "Forcing the Capacity of Fire-Tube Boilers," read a paper which showed that boilers of this type have a much greater overload capacity than has been recognized. He succeeded in obtaining, under satisfactory conditions, an evaporation of steam equivalent to 100 per cent overload, or even more.

The paper by Mr. G. C. Henning, entitled "Diamond Tools," describes, among other tools of this kind, a diamond die for drawing wire. It consists of a bronze block, in which a diamond is set and perforated by a tapering polished hole, through which the wire is drawn. The holes in these diamonds are rarely made larger than 0.064 inch diameter, because for larger sizes steel draw-plates are sufficiently accurate. The smallest dies of the diamond type which have come to the author's notice have holes of only one mil in diameter, although dies having holes less than half of this have been called for. It is common practice to make the holes in diamond dies accurate within one ten-thousandths of an inch. It has been found that diamonds wear increasingly when drawing the following metals in the order stated: gold, silver, copper, brass, bronze, platinum, soft steel, nickel, iron and crucible steel.

The convention was opened on Tuesday, December 6, by an address by the president, Mr. Ambrose Swasey, an abstract of which is given in this issue. During the convention, excursions were made to points of local interest, and a reception and conversazione was held at Sherry's on the evening of December 8.

PHYSICS AND ELECTRICITY.[1]

BY PROFESSOR WILLIAM HALLOCK.

In the course of his lecture before the New York Electrical Society on November 30, Professor Hallock said:

"It is in general not very profitable to spend much time in evolving an elaborate classification of the sciences and their interrelations, nevertheless it may at times be well to take a survey of the situation, a sort of bird's-eye view, without any especial reference to the boundaries, which are artificial and merely useful for ready reference.

"In a way 'physics' should be considered to include both the branches which we refer to under the name of physics and chemistry. *Phusis* and *phusikos* and *ta phusika* refer to the essence of all matter and its nature; nevertheless one branch of the subject has so grown out of proportion to the original trunk science that it occasionally forgets its relationship. We may say that the structure of the 'atom' of the chemist, the ultimate nature of primordial matter, is considered in the domain of physics, while chemistry busies itself with the combinations of these atoms into molecules, the results of the combinations of the molecules into masses and their behavior as such is again physics. Every great generalization, every marked step toward the goal has been in the nature of a simplification, a reduction of the number of the unrelated phenomena of nature. Usually we think of physics as dealing with elementary mechanics, sound, heat, light, electricity and magnetism. Sound has long since been properly classed as a particular case of the mechanics of elastic matter; heat and light, and most of the phenomena of electricity and magnetism have been similarly relegated to the domain of the mechanics of the 'ether,' and no one doubts that the other outstanding puzzle, gravitation, will also fall into this class. It is then the mechanics of the ether which must hold the solution of all of our conundrums, and that is the direction in which the vast majority of investigators are struggling at the present time. What are the relations of matter and ether, or are they identical? That is the question.

"In the latter part of 'the seventies' Sir William Crookes made a brilliant series of experiments upon what he then called 'radiant matter.' He showed very beautifully that when the greater part of

[1] Delivered before the New York Electrical Society, November 30, 1904.

the air is pumped out of a glass tube, and then a current of electricity sent through the gas by means of the electrodes, as A, K in the cut, that under these conditions there were sent out from the cathode small particles of matter, traveling at high velocities in straight lines until they struck the other side of the tube, or some intervening object. Ten or fifteen years later the investigation of this 'radiant matter' was taken up more vigorously and Lenard found that by placing a small aluminum window opposite the cathode, he could cause the 'cathode particles' to pass through the metal and travel some distance through the outside air. It has also been found that these particles carried a charge of negative electricity, and were consequently deflected by a static electric charge or by a magnetic field. In the last decade of the last century Rœntgen discovered that where one of these particles was stopped by striking upon some object a new form of radiant energy was sent out. Not knowing its nature he called it X-rays, being recognized the world over as the 'unknown quantity.' Becquerel soon after discovered that uranium emitted a sort of radiant energy, which was then called 'Becquerel rays.' In the meantime the 'radiant matter' of Crookes had come to be known as 'cathode rays,' and Goldstein had shown that a corresponding condition of matter carrying positive electricity could be produced, and called it 'canal rays.' We have then the cathode rays, particles of matter carrying negative charges; when one of these particles strikes, it produces a few waves in the ether, an 'ether pulse,' as when a stone is thrown into a pool of water, this is X-rays. The radiations from radium and its analogues were soon identified as follows: the alpha rays are particles of matter carrying charges of positive electricity, traveling with a velocity of about 20,000 miles per second, and about the size of two atoms of hydrogen, it would take $5 + 10^{23}$, *i. e.*, 5 followed by 23 ciphers of these alpha particles to weigh one gramme (a gramme is equal in weight to about fifteen grains). The alpha particles have a very slight penetrating power; two ten-thousandths of an inch of aluminum or a sixth of an inch of air will cut off half the alpha radiations. The beta radiations are the radiant matter of Crookes, the cathode rays of the present, particles of matter carrying negative electricity; traveling with a velocity of 160,000 miles per second, they are only one two-thousandths the size of the alpha particle and are much more penetrating, one-half passing through a fiftieth of an inch of aluminum or two inches of air. The gamma rays are like X-rays, a pulse in the ether, and travel with the velocity of light, 186,000 miles per second.

"By the deflection of the alpha and beta particles under the influence of a static field or a magnetic field, it has been possible to determine the above facts, and many other independent phenomena confirm them most beautifully.

"When a current of electricity is sent through a solution of common salt the molecules are immediately involved in a series of interchanges; all the atoms of the element sodium immediately start toward the negative plate, because they carry positive charges, and all the atoms of chlorine start in the opposite direction toward the positive plate, because they carry negative charges. Thus the mechanics of electrical conduction is a procession of positively charged particles, ions, traveling in one direction and a corresponding procession of negative ions in the opposite direction. This is the only way non-metals can conduct electricity. Air is ordinarily a non-conductor; it is not a metal and it has no positive and negative ions. Under the bombarding influence of the radiations above described, the air is broken up into ions and becomes a conductor, and its conductivity is a measure of the activity of the bombardment. Consequently we may use the conductivity imparted to air as a measure of the degree of radioactivity.

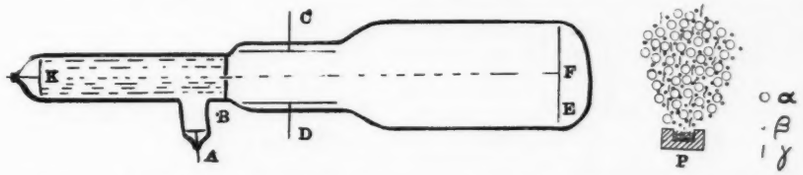
"Professor J. J. Thomson puts forward the hypothesis that the small particles of the cathode rays are the primordial form of matter from which all the elements are built up, and proposes the name of 'corpuscle' for them, but they are generally called 'electrons.' He even suggests very beautifully that the electron may be nothing more than a charge of negative electricity, and that when we have about a thousand of these combined with a neutralizing amount of positive electricity, we have an atom of hydrogen; sixteen thousand gives oxygen, etc. When a gas is ionized, for example, by a beta particle, it has one of its electrons knocked off, and consequently is left effectively positive, and the conditions are fulfilled for conduction of electricity.

"The researches of Rutherford, Soddy, Thomson, Ramsay, and many others have led to the following hypothesis as to the mechanics of radioactivity.

"The very large atom of radium, some 235 times as large as the hydrogen atom, is in a condition of unstable equilibrium, undergoing gradual disintegration, owing to a loss of some of its original internal energy. The first observable product is a gaseous material called by Rutherford 'emanation;' this gradually disintegrates farther, and as an end result we obtain helium, a very light inert gas, recognized by its spectrum. There are certainly other products, but they are not in sufficient quantity to be identified. Professor Ramsay has gone even farther, and thinks it possible that elements may be built up by bombarding into an element of lower atomic mass a certain number of alpha and beta particles.

"If these hypotheses prove tenable, it would appear that all physics, all matter, everything is electricity, and there is nothing in the so-called material universe but the ether and its mechanics."

A lengthened discussion followed during which Professor Hallock gave some most interesting additions to the subject matter of his valuable lecture.



ABCDEFK is a "Braun Tube." A is the anode; K the cathode; B a partition with a small circular opening; CD are wires connecting with two parallel aluminum plates inside the tube; and EF is a screen of fluorescent material. Between K and B are "cathode rays." KF is a stream of cathode rays which passes through the opening of B and when undisturbed strikes the screen at F. If C is given a strong charge of negative electricity and D a corresponding positive charge, then the particles, "electrons," of the cathode rays passing between these plates will be repelled by C and attracted by D and strike the screen at about E, because the electrons carry negative electricity. Alpha (small circle) represents the large particles sent out by radium, carrying a charge of positive electricity, and traveling with a velocity of about 20,000 miles per second. Beta (small black dot) represents the electrons sent out by radium, carrying a negative charge and traveling with a velocity of about 150,000 miles per second. Gamma (the long wigglers) represents the gamma rays or electric pulses (X-rays) sent out by radium and traveling with the velocity of light 186,000 miles per second. The alpha particles are about twice as large as an atom of hydrogen and the electrons are about one-thousandth of the size of the atom of hydrogen. P represents a lead box containing radium.

Convention of Illinois Electrical Contractors' Association.

The third annual convention of the Electrical Contractors' Association of Illinois was held at Bloomington, Ill., on Thursday, December 8. During the morning session addresses were made by C. L. Brown, Henry Newgard and Arthur Brantzen, of Chicago. The electric power plant of the Chicago & Alton Railroad was inspected during the afternoon, and the annual banquet was held in the evening.

Interstate Independent Telephone Association.

Fourth Annual Convention Held in Chicago, Ill., December 13, 14 and 15, 1904.

THE fourth annual convention of the Interstate Independent Telephone Association was held at the Auditorium Hotel, Chicago, Ill., December 13, 14 and 15, 1904.

The first session was called to order by President Henry A. Barnhart on Tuesday, December 13, at 2.30 P. M.

There was a brief debate upon the matter of credentials and the eligibility of various interests. A committee on credentials, including Matthews, of Kentucky, Holdoegel, of Iowa, and Fee, of Ohio, was appointed, after which the president delivered the annual address.

Mr. Barnhart called attention to the continuing growth and prosperity of the independent telephone interests. He did not wish to trespass upon the data which the secretary had compiled, and would therefore make no attempt to tell in detail the achievements of the independent companies. He called attention to the long-distance connections which the independent companies were establishing, and said it was imperative that entrance be made into Chicago.

Mr. Barnhart bespoke for the exhibitors the attention of all the delegates, and suggested that whatever was accomplished at the convention, the material good should be carried away by the attendants and utilized for the perfection of service in their home towns.

Following the reading of the president's address, the secretary, Mr. E. M. Coleman, presented his annual report. During the course of this report Secretary Coleman pointed out that the independent interests have, at this time, over 3,000,000 telephones in service. The toll line systems are being rapidly extended all over the country, and he expected soon to see a complete network reaching every town and city. In round numbers, 140,000 pieces of literature had been mailed from the secretary's headquarters during the year 1904. Traffic arrangements of great importance between a number of strong, independent, long-distance companies had been made, and such steps inaugurated as would prove of benefit to the independent movement throughout the country.

A report was called for from the express committee, of which Mr. George N. Bandy, of Des Moines, Iowa, was chairman. Mr. Bandy was not prepared to make a report, and said that enquiry had developed that the express companies are, in most cases, paying their telephone rentals.

The reports of the committees on freight rates, railroads, on Postmaster-General Payne's order, and the special committee on uniformity of equipment and standardization of apparatus, were deferred until a later session.

Upon calling for new business, Secretary Coleman addressed the meeting concerning the question of the consolidation of the Interstate Independent Telephone Association with what is known as the National Association. This latter association was, up to its recent convention in September, known as the Independent Telephone Association of the United States. Mr. Coleman said that he and some of his associates had taken such steps as would warrant them in suggesting that a plan had been outlined for the consolidation of these associations.

There was a brief debate concerning the advisability of taking up this matter in open session. The consensus of opinion was that Secretary Coleman should present the matter at large, when all points necessary for executive treatment could be taken up in closed session.

The secretary then read from the minutes of a conference of representatives of the Interstate Independent Telephone Association and the National Association. At this meeting, which was held at the Auditorium Hotel, Chicago, on November 18, 1904, the representatives for the Interstate Association were E. M. Coleman, Charles E. Hull and Henry A. Barnhart, and those for the National Association were James B. Hoge, J. G. Splain and Ed L. Barber. This conference effected formal organization by the election of Mr. Hoge as chairman, and Mr. Barnhart as secretary. It was agreed at the conference that the Interstate representatives should take this matter up before the convention in December and submit it to a committee to be appointed by the delegates at this convention. At this conference Mr. Coleman and Mr. Hoge both presented elaborate communications outlining the conditions and the importance of a consolidation of the two associations. It was the opinion of the joint committee, after full discussion, that a permanent consolidation should be effected; that a committee of ten be appointed, five men representing the National Association, and five men representing the Interstate Association; that this committee of ten determine when another convention of the independent operators should be held, which should be a joint meeting of the two associations, under the plan that might be adopted by the ten men constituting the joint conference. The object of this joint meeting would be the ratification of the work of the joint committee.

The president then addressed the convention briefly upon the auspicious opening of the session, and Secretary Coleman read an invitation from the American Steel and Wire Company, tendering a reception at its works at Waukegan, where a demonstration would be made of the manufacture of telephone wire. This invitation was unanimously accepted, and, upon motion of Senator Hull, adjournment was taken.

A thirty-minute recess was indulged in, after which the association went into executive session. At the executive session the proposition for consolidation of the two associations was taken into consideration. After a thorough discussion of the matter, it was decided that a committee of five be appointed, of which the president of the association should be a member, the newly elected president and secretary of the association two others, the fourth and fifth to be appointed by President Barnhart.

Following the executive session, the convention was adjourned to meet at 2 P. M., Wednesday, December 14.

WEDNESDAY'S SESSION.

The morning of Wednesday, December 14, was devoted to inspection of exhibits. At 2.45 P. M., President Barnhart called the second session to order.

Mr. O. M. Bake being ill, his paper, entitled "Why Independent Telephone Securities Do Not Command the Market Price They Deserve According to Their Earning Capacity," was passed.

Mr. Theodore Thorward, of South Bend, Ind., read an interesting paper on "What the Independent Telephone Companies Owe the Public—What the Public Owes the Independent Telephone Companies." The paper brought out a lengthy discussion. Mr. Thorward called attention to the necessity of giving the public the benefit of a good toll line connection with surrounding independent systems. The question was raised as to how the

independent companies were to obtain connections with the different commercial centres. A number of delegates joined in the discussion, pointing out their experiences.

A committee of three was appointed to wait on the Illinois Telephone and Telegraph Company and report at the next session as to what the prospects would be for getting a connection with the city of Chicago. If unable to obtain such information by that time, this committee was to report at a later meeting. Messrs. Barber, Veneer and Thorward were appointed to serve on this committee.

Mr. E. D. Graham, of Mexico, Mo., read a paper on "Manufacturers' Duties and Their Dues." He urged the manufacturers to be loyal and protect the operator who uses his goods, and thereby be in a position to demand his just credit from the operator.

Mr. John E. Jones, of Jonesboro, Ark., then read a paper on "Uniformity of Equipment and Standardization the Imperative Demand in the Operating Field." The paper was received with great interest, and a lengthy discussion followed. This paper pointed out the necessary elements which enter into the successful manufacturing of telephone apparatus, and the importance of a standard line of instruments. Mr. Jones urged the independent telephone companies to take prompt action to obtain the highest possible standard of perfection on all its apparatus, and to adopt a given standard of construction, equipment and apparatus.

THURSDAY'S SESSION.

President Barnhart called the closing session to order at 9.30 A. M., Thursday, December 15. Messrs. Reeves, of Indiana; Lichty, of Iowa; Graham, of Missouri; Hull, of Illinois; Mathews, of Kentucky; Fee, of Ohio, were appointed as a committee on nominations.

The question, "why independent telephone securities do not command the market price they deserve," was then taken up and discussed. It was stated that the proper way for the independent operators to secure investments in their plants is to first secure the support of their friends and neighbors who have a knowledge of the plant and confidence in the men running the company, and through this confidence the outsiders will come in and invest their money in independent securities.

It was announced by President Barnhart that it had been decided not to hold a banquet, this decision being made after a discussion with the delegates.

The paper on "How to Avoid Personal Injury and Responsibility in Telephone Construction Work and Maintenance" by Senator Rome C. Stevenson, of Rochester, Ind., was read. This paper pointed out how to protect the different companies from damages for such personal injury. It urged that only material of the best character be used and that it be thoroughly inspected by an engineer, and that great care be taken in building lines. The operators should realize the difficulties that are before them, and, having this knowledge, endeavor to overcome this difficulty when equipping their lines. The paper brought out a number of experiences different companies have had in the different suits for personal injuries. A number of important decisions of suits were given. In the discussion which followed a number of the operators spoke of their experiences in suits for personal injury. It was urged that the independent companies use only the best construction and secure the service of competent men.

The committee appointed to wait on the Illinois Telephone and Telegraph Company reported through the chairman, Mr. Barbour, that the president of the company, Mr. Wheeler, stated that if the independent companies would do their part of the work and bring their lines to the city limits with the assurance that the companies used standard equipment, that this company will be able to entertain a proposition in from three to six months to enter Chicago. President Wheeler stated that the Illinois Telephone and Telegraph Company is as anxious to obtain connections with the surrounding operators as any one else, and would do all possible to push the work.

Secretary Coleman read a report of the committee on Postmaster-General Payne's order.

The following officers were elected:

President, Theodore Gary, Macon, Mo.

Vice-President, William R. Fee, Milford, Ohio.

Secretary, L. L. C. Brooks, Minneapolis, Minn.

Treasurer, A. B. Conklin, Aurora, Ill.

Executive board, the Hon. C. E. Hull, Salem, Ill.; S. S. Lichty, Vinton, Iowa; J. G. Splain, Pittsburg, Pa.; Richard Valentine, Janesville, Wis.; W. Mathews, Mayville, Ky.; E. D. Graham, Mexico, Mo.; Charles W. Wells, Marion, Kan.; H. F. Barnhart, Rochester, Ind.; W. Guy Jones, Columbus, Ohio.

The meeting was then adjourned.

The afternoon was then devoted in visiting the works of the American Steel and Wire Company, at Waukegan, Ill. A special train left over the Chicago & Northwestern Railway at 12 noon. Lunch and refreshments were served on the train. The visitors were greatly interested in being shown how telephone wire is made. The special train returned to Chicago at 4.30 o'clock, and the delegates expressed themselves as having spent a most enjoyable trip.

EXHIBITORS AT THE CONVENTION.

The Ericsson Telephone Company, New York city, was represented by Mr. J. H. Montag and Mr. George H. Pierce.

The Miller Anchor Company, Norwalk, Ohio, was represented by Mr. G. H. Miller, president, and Mr. F. B. Miller, vice-president.

The Fibre Conduit Company, Orangeburgh, N. Y., was represented by W. W. Smyth, Jr.

The Gray Telephone Pay Station Company, Hartford, Ct., was represented by George A. Long, Jr.

The Central Telephone and Electric Company, St. Louis, Mo., was represented by J. S. Cummins, president, and W. F. Gray.

The Stombaugh guy anchor was effectively represented by Mr. Claude L. Matthews, Jr., member of the firm of W. N. Matthews & Brother, of St. Louis, Mo., manufacturers of the Stombaugh guy anchor.

The Century Telephone Company, Buffalo, N. Y., was represented by W. W. Kidney, engineer, and Gustave F. Bauer.

The Kester Electric Manufacturing Company, Chicago, Ill., was represented by A. G. Dickerson, J. E. Goodwin and E. A. Simpson.

The Elliott Addressing Machine Company, Chicago, Ill., was represented by R. St. John.

The American Steel and Wire Company was represented by George Chandler, F. R. Warner, C. J. Conklin and W. C. Bogue.

Francis Beidler & Company, cedar poles, Chicago, Ill., was represented by R. R. Genge.

A number of the exhibitors were located in the Victoria and Great Northern hotels.

Meeting of the American Institute of Electrical Engineers.

The one hundred and ninety-second meeting of the American Institute of Electrical Engineers will be held in the chapter room of Carnegie Hall, 154 West Fifty-seventh street, on Friday, December 23, 1904, at 8.15 P. M.

The following paper will be presented and discussed: "The Maximum Distance to Which Power Can Be Economically Transmitted," by Ralph D. Mershon, member, consulting electrical engineer, New York and Montreal.

John B. McDonald in the Metropolitan.

Mr. John B. McDonald, whose resignation from the Interborough interests was recently announced, has been made a member of the executive committee and a vice-president of the Metropolitan Securities Company. Mr. McDonald was elected to his new offices at a meeting of the Metropolitan stockholders, held at noon, Wednesday, December 14. He takes the place on the board of directors which has been held by Mr. R. W. Meade. The other four members of the company's directorate were reelected.

National Carbon Company Receives Grand Prize.

The National Carbon Company, Cleveland, Ohio, has received a grand prize at the Louisiana Exposition for all of its carbon products, including Columbia enclosed arc carbons and Columbia dry batteries. The company states that the Columbia carbons are to-day used in about ninety per cent of the enclosed arc lamps in service.

THE UNDERWRITERS' ELECTRICAL MEETING.

REVISION OF NATIONAL ELECTRICAL CODE.

On Wednesday and Thursday, December 7 and 8, the electrical committee of the Underwriters held their annual meeting at the hall of the New York Board of Fire Underwriters, 32 Nassau street, at which F. E. Cabot presided and C. M. Goddard was secretary.

The object of this meeting was to consider any propositions to amend or extend the National Electrical Code. This code was drawn in 1896 by a conference of representatives of the American Institute of Electrical Engineers, and other technical societies of engineers, and numerous other electrical and insurance interests.

This code which was adopted by the participators was also adopted by the National Board of Fire Underwriters as a standard, and their committee of ten electric specialists hold these annual meetings to consider the various suggestions which are offered.

In this manner the rules have grown to about double the former size and the remaining provisions have been so modified as to render the original code a mere nucleus of the present manual constituting the code.

This meeting appears to be advisory in that the electrical committee of ten members submitted a four-page sheet of amendments for the consideration of the 150 persons in attendance, and beyond that new matters required a unanimous vote for their presentation to the meeting.

However, the presentation of all printed amendments was accompanied by a statement on behalf of the committee whether it had received their approval.

It was understood that the votes were to be taken as advisory expressions of the consensus of opinion of those present.

There were delegations from the societies which first drew the code in attendance.

The report of committees on car-wiring, switches and thickness of insulating material were received.

The amendments which received the approval were less numerous than usual, the majority of them being defeated.

It was stated by the chair that the policy of the committee was to reach results rather than to dictate details, and it appears as if this might well be applied to a revision of the present rules, which have year by year extended to a far greater length than appears to have been originally contemplated.

BOOK REVIEWS.

"Lamp Lighting Schedule—Moonlight System for 1905." F. B. Badt. Chicago. Electrician Publishing Company. Paper. 32 pages. 3½ by 5¾ inches. Supplied by the ELECTRICAL REVIEW at 10 cents.

This moonlight schedule is based on mean local time, as given in the calendar for 1905, and applies to a latitude of about forty-one degrees. This means approximately New York city, Philadelphia, Connecticut, Pennsylvania, New Jersey, Ohio, Indiana, Illinois, Nebraska, Iowa, southern Michigan and southern Wisconsin.

"Traité Théoretique et Pratique d'Electricité." H. Pécheux. With additional notes by J. Blondin and E. Néculcéa, and a preface by J. Violle. Paris. Librairie Ch. Delagrave. Cloth or paper. 720 pages. 6½ by 10 inches. 800 illustrations. Supplied by the ELECTRICAL REVIEW—cloth, $5; paper, $4.25.

This is a theoretical and practical study of electricity, and has been prepared for use in the electrical course of the National School of Arts and Measures, Aix, France. The entire subject is covered here, including static and dynamic electricity, the mathematical theory, measurements and instruments, and the design and construction of electrical machinery, and its use in the various arts. The subject matter has been brought well up to date, though some of the apparatus described is obsolete, and might have been omitted.

"Résistance, Inductance et Capacité." J. Rodet. Paris. Gauthier-Villars, Imprimeur-Libraire. Paper. 258 pages. 5½ by 9 inches. 76 figures. Supplied by the ELECTRICAL REVIEW at $1.75.

This is a very complete treatise on the three properties of electric circuits. It is particularly interesting, as it is an elaboration of notes made by the author, who is a practical engineer, and who has found his way of dealing with these phenomena useful. The book consists of three chapters, the first treating of resistance. The usual analytical consideration is followed, and methods of measuring are explained, as well as measuring instruments. Tables of resistances of metals, alloys and insulating materials are included, together with brief descriptions of a number of interesting devices, such as rectifiers. Chapter ii deals with inductance in a similar manner, and chapter iii with capacity.

"A. L. A. Catalogue." Melvil Dewey, editor. Washington, D. C. Government Printing Office. Part I (classed), 403 pages; part II (dictionary), 486 pages. 8 by 10 inches. Supplied by the Superintendent of Documents, Washington, D. C. Cloth, 50 cents; paper, 25 cents. Part I or part II, separately—cloth, 25 cents; paper, 15 cents.

This is a catalogue of about 8,000 volumes, selected as suitable for a popular library. It has been prepared by the New York State Library and the Librarian of Congress, under the auspices of the American Library Association Publishing Board. Part i gives a classified list, indexed according to the Dewey system; while in part ii the works are arranged alphabetically under the authors' names. Of the total number of books listed, 471 are devoted to natural science, and 453 to the useful arts, including engineering. Under electrical engineering there are twenty-three works, among them several classic treatises. The list, as a whole, is good for the purpose intended, though it is not one which we would recommend as a suitable library for the young engineer.

French Imports and Exports of Electrical Material.

The imports and exports of arc lamps, arc lamp carbons and accumulators in France during the past six years are here discussed by M. A. Liouville. The importations of arc lamps in 1898 were valued at $10,000. In 1899 this had risen to nearly $16,000. In 1900 the value was $14,000, and since then has been approximately $12,000. The greatest factor in this business is Germany, which furnishes about three-quarters of the arc lamps imported into France. The duty on arc lamps is about twelve per cent, which, as shown, is not prohibitive. The commerce in arc lamp carbons is in marked contrast to that of arc lamps, for the exportations of arc lamp carbons from France far exceed the importations. Beginning with 1898, the value of the carbons exported from France was $193,000, and it has increased fairly steadily until, in 1903, it was $355,000. The value of the carbons imported into France was, in 1898, a little over $14,000. This increased in 1900 to $45,000 and then decreased, being, in 1903, $16,000. The fact that the exports were so much greater than the imports, in spite of the average duty on the exports of twenty-five per cent, is thought to indicate that the French carbons are of a superior quality. The imported carbons came chiefly from Germany, and the same country consumed the greater part of those exported, Belgium coming next. In comparison with the business in arc lamp carbons, that done in storage batteries is small. The importation of accumulators into France in 1898 is valued at a little over $27,000. Since then the value has decreased rapidly until, in 1902, it fell to $8,000. The following year there was a notable increase, the value going up to $23,000. The value of the storage batteries exported from France in 1898 was about $22,500. In 1900 there was a decrease, followed by an increase in 1901, which continued until 1902, when the exportations were valued at about $30,000.—*L'Industrie Électrique (Paris), November 25.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

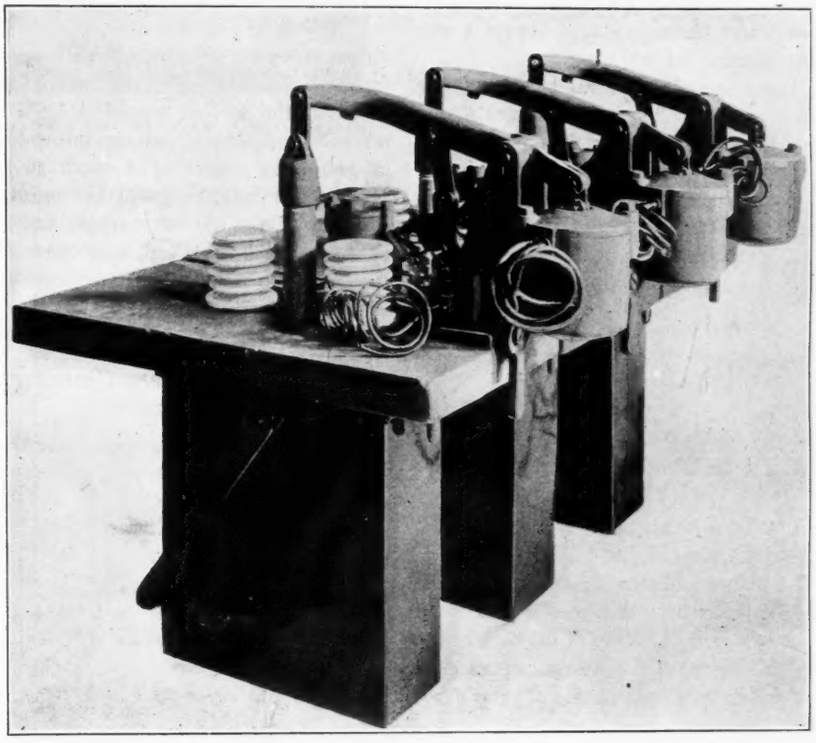
Westinghouse Oil Circuit-Breakers.

The Westinghouse Electric and Manufacturing Company has begun the active sale of a new automatic coil circuit-breaker of especial merit, which is listed as its electrically operated type E. It is adapted to the most modern system of distant control and is designed for voltages from 3,300 to 25,000.

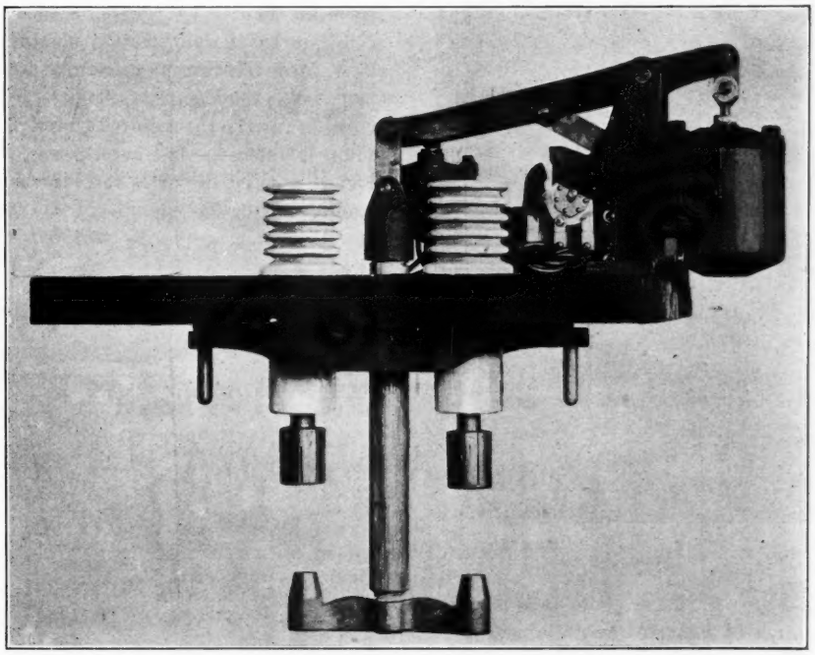
Systems of very high voltage and capacity have received much attention from engineers, but a definite demand has arisen for a piece of apparatus of somewhat smaller capacity, which shall be compact, reliable and suited for electrical operation. The Westinghouse system of solenoid operation is especially adapted to such a form of apparatus, and has been used in the new line of circuit-breakers.

The circuit-breaker is made in single-pole units, each being mounted apart from the switchboard in a brick or concrete compartment.

Two, three and four-pole combinations are made by placing the units side by side. The base of each unit is of treated soapstone and holds two heavy porcelain insulators which carry the stationary contacts and the connection to the external circuit. The movable contacts are at the ends of a U-shaped metal casting fastened at the centre to a rod of treated wood, which is moved up and down by the operating mechanism in closing or opening the circuit. The final arc on breaking the circuit is taken by an arcing tip which may easily be replaced.



BANK OF AUTOMATIC OIL CIRCUIT-BREAKERS.



AUTOMATIC OIL CIRCUIT-BREAKER, TANK REMOVED.

The contacts are of the typical Westinghouse design. The movable contacts are in the shape of truncated cones and fit into corresponding surfaces in the stationary contacts which are made up of a number of copper springs. This arrangement not only gives a large area of contact, but ensures a positive contact over its entire surface, and entirely prevents "freezing" under any condition of overload. The tanks are liberally insulated and the inner surfaces so shaped as to reduce the amount of oil required, and therefore the fire risk to a minimum. The open position is in all cases maintained by gravity.

A simple system of levers and toggles is mounted on the top of the base and a powerful electromagnet is arranged with its movable core attached to the lever systems, so that when the magnet is energized the circuit-breaker will be closed. The standard voltage used on the solenoid is 125 volts. A second electromagnet acts as a tripping coil and may be controlled by a relay of any desired type. A small single-pole double-throw switch is mounted on the base, and is operated by the motion of the levers in opening or closing this circuit, it controls

the tell-tale indicator and lamp which are mounted in view of the operator.

The entire mechanism is compact and solid in construction, while the insulation has been carefully provided for. As in other Westinghouse oil circuit-breakers, the break takes place near the surface of the oil instead of at the bottom where there is almost always a certain amount of sediment.

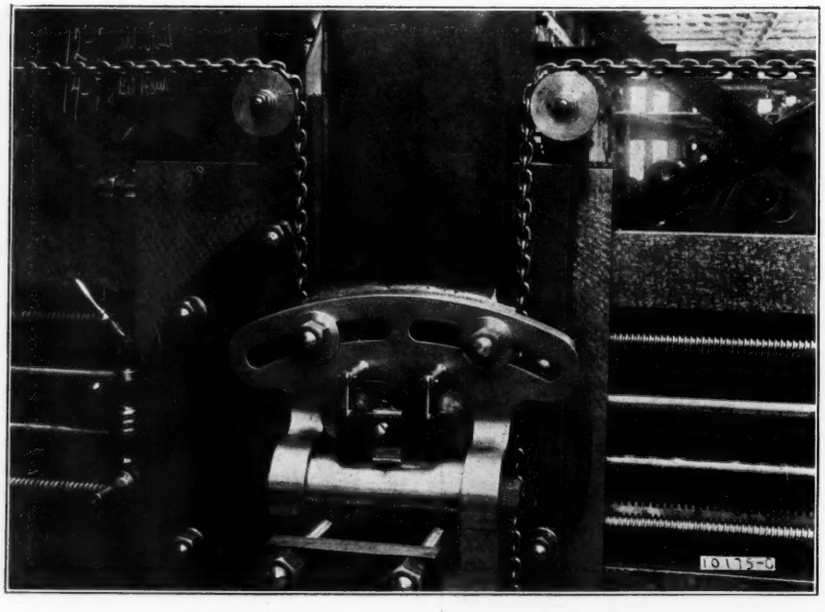
These circuit-breakers have no live parts exposed. The oil tanks are firmly held in position by special holders which, by the simple movement of a lever, may be removed and all contacts examined without disturbing any other part of the circuit-breaker.

The ultimate breaking capacity of the type E circuit-breakers is, for single-phase, 6,000 kilowatts; two-phase, 12,000 kilowatts; three-phase, 10,400 kilowatts. They will open circuits of these capacities under any condition of overload or short-circuit.

Magnetic Tool-Lifting Device for Planers.

The Niles-Bement-Pond Company, New York city, has devised an apparatus to lift a planer tool away from the cut at the end of the cutting stroke, and thus avoid wear and grinding away of the back of the tool. The apparatus consists of an electromagnet and armature. The electromagnet is attached to the clapper box, and the armature is suspended directly in front of the magnet and straddling the tail of the tool apron. Exactly at the moment of reversing the electromagnet attracts its armature and forces the armature against the tail of the tool box, thus lowering the tool and raising the free end of the tool box. The armature is released at the end of the return stroke. The timing is so arranged that no extra long stroke is required when this device is used. It will act equally well in all positions of the rail or saddles, and at any angle of the swing.

Current is led into the magnet by means of a lamp-cord suspended from the top of the planer. The amount of relief given to the tool is regulated by a set screw. The device may be thrown out of action by means of a small switch. It does not interfere with the ordinary working of the tool and apron, and the apron can be lifted up for renewal of tools, etc., without disturbing any part of the tool-lifting device.



Magnetic Tool-Lifting Device for Planers.

An Electrically Driven Centrifugal Oil Separator.

The centrifugal oil separator shown in the accompanying illustration has been designed by the American Tool and Machine Company, of Boston, Mass., especially for use in shops where the oil used on the machinery as a lubricating and cooling agent finally reaches the same drip pan as the chips and turnings. The purpose of the outfit is to separate by centrifugal force from these turnings, etc., oil which ordinarily goes to waste, as it can not be recovered by draining.

The material from which the oil is extracted is placed in a movable metal pan having sloping sides and a bronze sleeve which surrounds the spindle. This pan is fitted into a similarly shaped casting and securely fastened to the spindle. A circular top is screwed down over the pan containing the oil-soaked scrap to within about one-sixteenth inch of its brim. When the machine is started up the inner pan revolves with the spindle, and the centrifugal force drives the oil up the sloping sides of the pan and out through the opening between the pan brim and lid. The oil then falls upon the inside of the outer casting and drains off through an inlet.

Motor-Driven Centrifugal Separator.

It ordinarily takes from five to eight minutes to separate the oil from 750 cubic inches of material. This is the capacity of the machine shown in the illustration. Oil thus recovered can be used over and over indefinitely. There is, of course, some waste, but this is small in comparison to the amount lost where no separator is used. In the illustration shown the size 1, form L motor manufactured by the Crocker-Wheeler Company, Ampere, N. J., is used to furnish the required power. This motor is rated at one horse-power, and runs at a speed of 1,250 revolutions per minute, driving the spindle of the separator through a bevel gear at 1,800 revolutions per minute.

New Electrical Specialties.

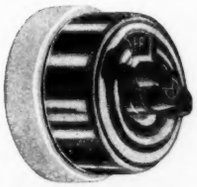
The Marshall Electric Manufacturing Company, Boston, Mass., has placed on the market a new form of cord adjuster

Cord Adjuster.

for the manipulation of cords for incandescent lamps. The company is also the manufacturer of the Dow adjuster, which

has achieved great success in this field. The company has designed the new cord adjuster to be used where goods of the class of the Dow adjuster are not required. This new adjuster is designated as the "Open Cord Adjuster." Although this adjuster does not roll up the cord in the manner of the Dow adjuster, it can be worked with one hand, and is satisfactory for many places.

Recognizing the demand for a high-grade indicating switch, the company has recently perfected and put on the market

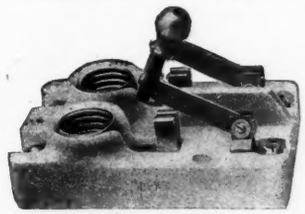


INDICATING SWITCH.

a switch of this character which has some novel features. In addition to the hardened steel mechanism and indicating dial, the moving current-carrying parts are all insulated from the mechanism by sheet mica, and are loosely held for better contact with the stationary contacts. The binding screws are eccentrically drilled, giving a greater thickness for the binding screw thread. The whole switch is encased in an extra heavy cover lined with one piece of solid "Elastoid" fibre lining. These switches are made in single-pole, double-pole, three-point, four-way, two and three-step electrolier and 500 volts.

Combination Switch and Plug Cutouts.

A new line of combination switch and plug cutouts has been placed on the



TWO-WIRE MAIN, TWENTY-FIVE-AMPERE SWITCH.

market by the H. T. Paiste Company, Philadelphia, Pa. These are designated as

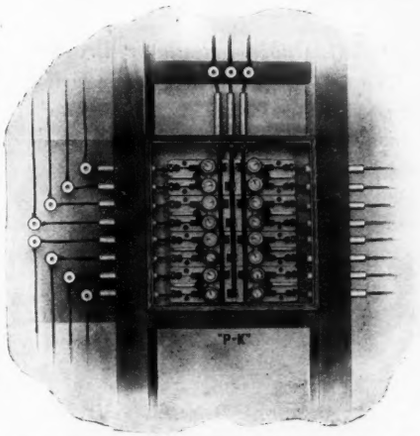
TWO-WIRE SINGLE-BRANCH, FIFTEEN-AMPERE SWITCH.

the "P-K" panel cutouts. The line comprises twenty-five and thirty-ampere mains for 125 and 250-volt circuits, and single and double-branch blocks for both two and three-wire circuits. In addition to the six styles of cutouts in this line, the company is prepared to furnish complete

THREE-WIRE TO TWO-WIRE, DOUBLE-BRANCH, FIFTEEN-AMPERE SWITCH.

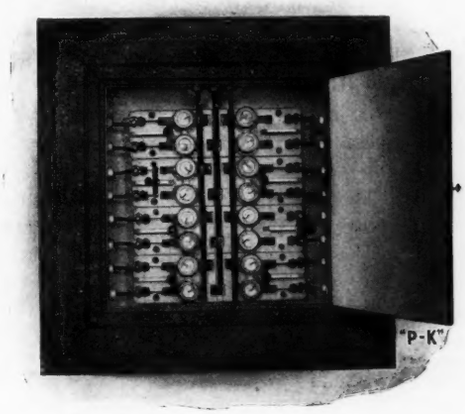
wooden panel-boxes and oak fronts, with quartered-oak doors for the same.

The wooden boxes are lined throughout with one-eighth-inch asbestos board and are ready for setting in the studding. The fronts are mill finished, smooth and ready for varnishing or painting, and are com-



BOX IN PLACE, BEFORE PLASTERING IS DONE.

plete with hinges, rim lock and key. This is an entirely new line, and eliminates the necessity of the wireman calling upon the carpenter to build his box and line it



BOX OPEN, SHOWING WIRING.

with two or three thicknesses of asbestos cloth to bring it up to the required one-eighth-inch thickness, and finally get a mill to make the fronts. With this line of material at his service, the wireman can build his own panelboards for any number of circuits. The material has been approved by the National Board of Fire Underwriters.

The Stroud System of Measured Service.

The Controller Company of America, Chicago, Ill., has placed on the market a

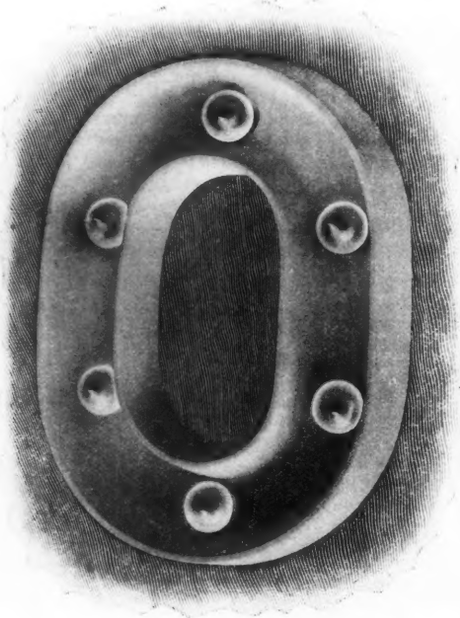
MEASURED SERVICE CONTROLLER.

combination device making up a telephone instrument and coin collector. The accompanying illustration shows the No. 1 controller mounted upon a pressed steel base or backboard of rectangular shape with rounded corners, and having a depth of one inch. In this base is mounted the self-contained switch used on all of the company's apparatus. The lever extends through a punched slot in the left side, and is turned outward at an angle of forty-five degrees. The transmitter is carried on an adjustable arm below the controller, the arm base being screwed with four screws to the projection thrown out from the base.

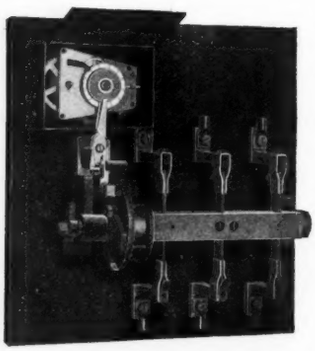
In the base, besides the switch hook, are also an induction coil (when used) and a strip of connectors to which the circuits terminate. The two at the left are for the receiver, and the two at the right are provided for an extension bell which can be placed out of view, but where it may be heard by the subscriber.

Window Lighting and Electric Signs.

The American Electric Sign Company, 133 Summer street, Boston, Mass., is calling attention to its electric sign letters for advertising purposes. The company supplies a solid porcelain letter, which may be made in various sizes and adapted to almost any form of advertising by illumination. The solid porcelain letter is made by the Colonial Sign Company. It stands out in plain relief at almost any distance, is weatherproof, and does not require painting or refinishing under long periods of service. This company also supplies sign flashers made by the Reynolds Manufacturing Company, for turning on and off any number of lights for advertising signs.



"Colonial" Electric Sign.



Automatic Time Switch.

The American Electric Sign Company is the manufacturer of a time-switch device for turning on the current for store-window illumination at a predetermined hour. This time-switch may be set for any period of the night or day, and automatically opens or closes the circuit, as desired.

An Adjustable Telephone Bracket.

The accompanying illustration shows a new form of adjustable telephone bracket. This bracket is adapted for roll or flat-top desks, or walls or partitions. It is so arranged that several movements may be secured with different arrangements of the levers. The telephone is easily adjusted and the instrument placed out of the way when not in use. The attachment lug is so arranged that it can be applied to either side of the desk.

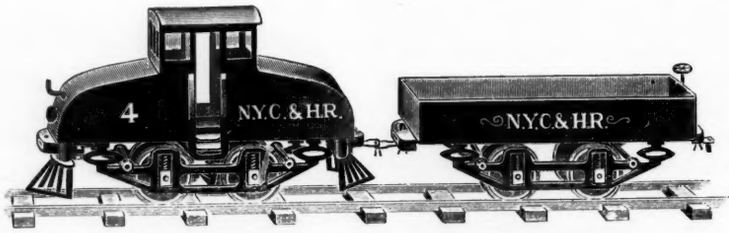
Method of Using Hughes Adjustable Telephone Bracket.

The Eastern Telephone Manufacturing Company, West Chester, Pa., successor to the Hughes Telephone Manufacturing Company, is the manufacturer of this apparatus. The selling agents of this device are Schofield & Company, 150 Nassau street, New York city.

Hughes Adjustable Telephone Bracket.

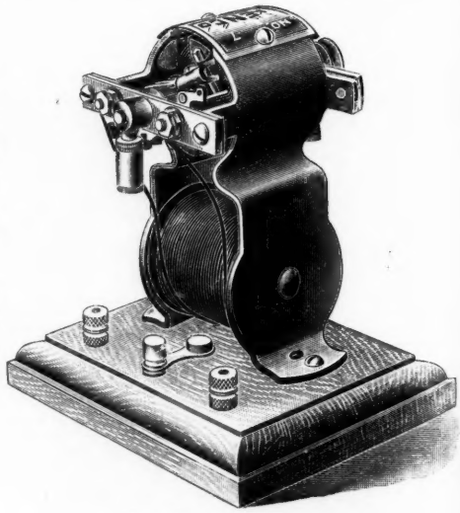
Electric Toys.

The Knapp Electric and Novelty Company, of No. 503 West Fifty-first street, New York city, is calling attention to a high-class line of electrical toys for holiday distribution. The accompanying illustration shows the "Kenco" motor, No. 7, and the No. 6 electric train. The No. 7 motor is a miniature power machine in every respect. The field is made from electrical steel punchings, and the armature is of the drum type, with six slots. The brushes are adjustable while the motor is running. It is made with automatic-feed oil cups, and a pulley for driving mechanical appliances. The machine is mounted on a heavy base fitted with a starting switch. The finish is black enamel, the brass parts being nickel-plated. Special windings for special work will be made for these motors if ordered in quantities. The weight is three and one-half pounds; height, six inches. The pressure is from four to eight volts, with current from one-half to three-quarters ampere.



Toy Electric Locomotive and Freight Car.

The electric train outfit consists of one locomotive, one coal car, two lengths of track nine feet, each of two-inch gauge, with cross-ties and connectors. The locomotive is a miniature representation of the New York Central electric locomotive.



Toy Electric Motor.

A New Speed Jack.

The Reed-Morrill Electric Company, 1035 Ridge avenue, Philadelphia, Pa., has placed on the market a speed jack.

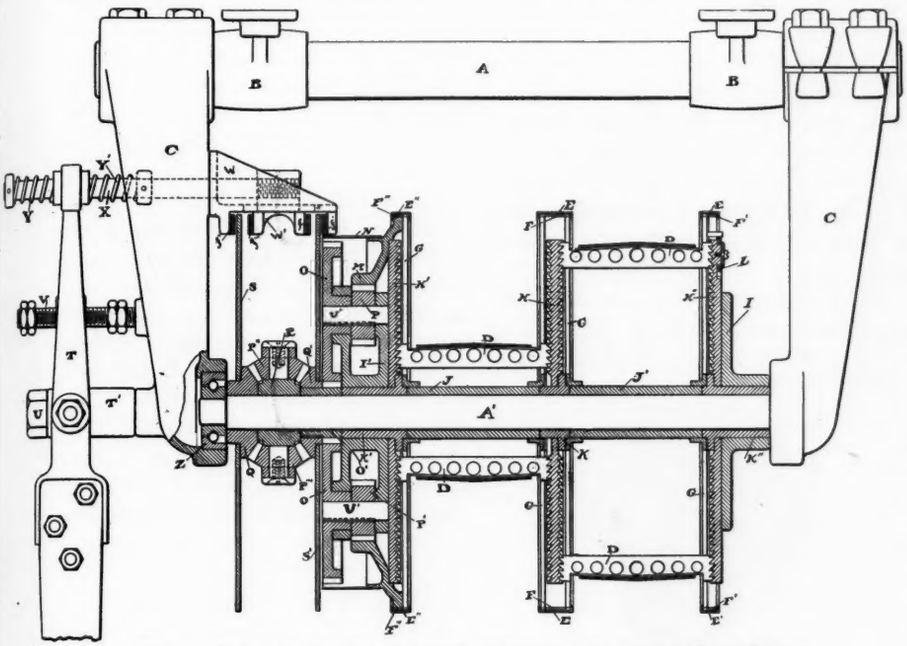


FIG. 1.—SPEED JACK FOR OBTAINING VARIABLE SPEED WITH BELT DRIVES.

The object is to obtain variable speed with belt drives. The device is shown in section in Fig. 1.

The surface of the pulleys consists of about fifteen slats D, which engage two discs H with spiral grooves cut in them. The spirals are left-handed for one pulley, and right-handed for the other. Inside of the discs H are two plates with fifteen radial slots in which the slats are free to move. P, Q and R are a set of bevel gears which are driven by the discs S and S'. Either one of these discs may be held stationary by means of the friction clutch W. When the speed of the machine to which the jack is attached is to be varied, the shipper T is thrown one way or the other and locks S or S'. The discs H then revolve, being driven through the train of gears P, Q and R, causing the slats on one pulley to move outward and the slats on the other to move inward. As the diameter of the pulleys changes the position of the jack is varied, as shown in Fig. 2, thus compensating for the different length of belt necessary, due to the changed diameters. The shipper is held in one position until the desired speed is attained. It is then placed in its midposition and the outward and inward motions of the slats cease, and the jack runs as a pair of ordinary countershaft pulleys. There is no tendency of the apparatus to automatically change from one speed to another, and no special quality of belting is required. The speed jack is noiseless and is mounted on ball bearings. There are no end thrusts or stresses between the component parts of the apparatus.

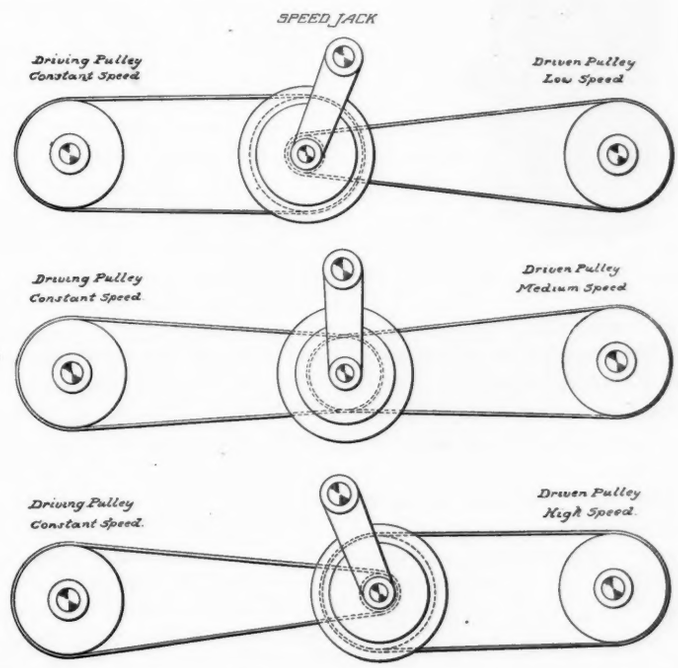


FIG. 2.—METHOD OF VARYING THE SPEED WITH BELT DRIVES WITH THE SPEED JACK.

Power Plant for the Quintard Iron Works.

Messrs. Bates & Neilson, consulting electrical engineers, of New York city, have been employed by the Quintard Iron Works Company to design and prepare specifications covering a complete electric and steam generating power plant for the supply of light, power and heat to its present office building and shops which are located at avenue D and Twelfth street, New York city.

It is contemplated to install two water-tube boilers of 150-horse-power capacity, each at 150 pounds steam pressure, provision being made for the installation of an additional boiler should same be required later on. The second story of this new power plant building will contain large bins for the storage of coal.

The boilers which will be installed in the south end of the ground floor of the new building will be separated from the engine room by a twelve-inch brick wall. The steam mains will pass through this wall to the engine room, where they will feed two 100-horse-power engines, one fifty-horse-power engine, one nine-inch by ten-inch by nine-inch duplex air compressor and one nine-inch by nine-inch by nine-inch simplex air compressor. The feed pump for the boilers will be a motor-driven triplex and will be supplemented by a steam-driven duplex which will serve as an auxiliary.

To each of the 100-horse-power engines will be directly connected a dynamo of sixty kilowatts, and to the fifty-horse-power engine, a thirty-kilowatt direct-connected dynamo.

The current generated will be of 250 volts direct, and by a five-panel switchboard, which will also be installed in the

engine room, will be carried to the present system of conductors for distribution for both light and power.

The capacity of the generating plant as at present laid out calls for 150 kilowatts in all at normal rating and provision has been made for suitable space to be left for the installation of an additional unit of sixty kilowatts in case the electrical requirements of this plant should make such an extension necessary.

The heating system which will be installed will be one which shall make use of the exhaust steam.

The building of this power plant will be of brick and steel construction, and will replace a one-story building which is now used only for the storage of castings, etc.

The Bastian Electrolytic Meter.

The Helios Manufacturing Company, Philadelphia, Pa., is making a simple type of modern electrolytic meter well known as the Bastian meter. This apparatus is particularly well known in England, where it has been in commercial use for some years. In this meter the electric current decomposes the water of an electrolytic solution, the level of which is gradually lowered in proportion to the amount of current which passes.

In older styles of electrolytic meters the electrolyte consisted of a very dilute solution of sulphuric acid and water, to which was added a non-freezing mixture. Platinum electrodes were used with this solution, requiring vulcanite tubes for support and protection.

In the meter as constructed to-day, and which represents the highest development in this direction, it has been found that with pure nickel electrodes immersed in an alkaline solution, the vulcanite tubes and box are not necessary. A simpler and stronger construction is therefore permitted. Besides this, the new alkaline solution is found to be practically non-freezing, and as the nickel electrodes are much larger, the resistance of the cell is reduced. The drop becomes about that necessary for the decomposition of water —a little less than two volts. The electrolyte changes in resistance somewhat, according to its density, but as no shunt is required in the meter, and as all the current passes through the solution, there is no resulting error.

At all points of the curve this electrolytic meter is quite accurate and registers all the current which passes through it. This accuracy upon extremely light loads is important, as the meter is especially designed for use where a large number of small consumers are concerned.

The electrolytic meter is not affected by vibration, and is free from many of the alleged weaknesses of the commutator motor meter.

The Bastian electrolytic meter must be filled with water periodically. One filling lasts usually from four to six months. The record is indicated plainly on the meter on a straight-line scale. This makes it possible for even the most unenlightened to understand the reading of the instrument.

Where a three-wire service is used, two recording elements, enclosed in a single case, are employed, one being connected

Bastian Electrolytic Meter.

to each of the outer mains. This arrangement shows the consumption on each side of the circuit. In case of trouble it is also advantageous, as the registration of the meter is not disturbed by a reversal of current.

The Bastian meter will stand shipment to any part of the world with no loss from breakage. The use of glass in this meter is confined to a simple tubular form of receptacle for the electrolyte. This tube is firmly supported and well protected by a metal case.

The meter is designed particularly to meet the requirements of the small consumer. It is here that a reliable meter is needed—easy to install, inexpensive to operate, and having a low first cost.

The Crocker-Wheeler Company Secures an Important Contract.

The California Gas and Electric Corporation, San Francisco, Cal., has just placed an order with the Crocker-Wheeler Company, Ampere, N. J., for three 4,000-kilowatt, three-phase, 13,200-volt, twenty-five-cycle, eighty-three revolutions, revolving-field alternators, to be driven by 6,000-horse-power gas engines. The gas engines will be built by the Snow Steam Pump Company, Buffalo, N. Y.

The Crocker-Wheeler Company, as was announced some time ago, has entered the field of manufacturing alternating-current apparatus. The alternators to be delivered to the California company will be entirely constructed at Ampere, N. J., and will represent the highest development in revolving-field alternator construction. The apparatus will, in all likelihood, be used for producing current for the urban and interurban railways in and about the city of San Francisco.

Large Factory Plant for Sale.

The plant of the United States Carbon Company, Cleveland, Ohio, which is being advertised for sale, is exceptionally well located with regard to railroad and shipping facilities. In addition to this, the plant has its own power equipment, lighting and heating systems, and all modern facilities. Full information will be supplied concerning this opportunity by addressing the Guardian Savings and Trust Company, of Cleveland, Ohio.

Electric Tramway for West Fife, Scotland.

A company has been formed at Dunfermline, Scotland, writes United States Consul John N. McCunn, by local parties to build an electric railway through the west of Fifeshire. The promoters have given notice to the Fife county council, the corporations of Dunfermline, Inverkeithing, Cowdenbeath and Lockgelly of their intention to apply to parliament for a provisional order to carry out the scheme. The stock will be floated, and it is expected that the company will begin the construction of the road in the spring of 1905. The road will be sixteen miles in length, and besides connecting the towns mentioned, will ultimately touch the new naval base on the Firth of Forth. The estimated initial cost is $632,645. The Fife Electric Power Company, which is now building a power plant at Dunfermline, will supply the power required for all purposes in the operation of the tramway system when completed.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CALIFORNIA ELECTRIC ROAD CHANGES HANDS—It is reported that the San Jose & Santa Clara Railway has been sold to J. T. Parkinson, of Palo Alto. The price paid is said to have been $1,000,000.

NEW THIRD-RAIL LINE PROJECTED NEAR CLEVELAND—It is said that a ninety-six-mile third-rail electric line will shortly be constructed connecting Cleveland, Ravenna, Congress Lake, Canton, Zoar, and Canal Dover. J. V. Ward, of Cleveland, is said to be back of the scheme together with some Boston capitalists.

ELECTRIC RAILWAY FOR CENTRAL AMERICA—It is reported by the United States consul at Guatemala City that the street car system at that place may soon be operated by electricity instead of by mules, as at present. There are now over seven miles of track in operation, and the length is constantly being added to. Electric power can be secured from a water-power plant located about thirty miles from the city.

PROJECTED MAINE TROLLEY—It is stated that an electric railway will be constructed from Presque Isle to Washburn and Perham, in Maine, next year. The road will be chiefly employed for moving freight. The Aroostook falls will be developed in order to provide the necessary power. Over a year ago the Maine-New Brunswick Electrical Power Company was formed and a charter secured from the New Brunswick legislature for the development of these falls. About 4,000 horse-power can be developed.

TROLLEY SYSTEM PLANNED FROM BUFFALO TO CHICAGO—A statement has been made that with the building of the Chicago, South Shore & South Bend Interurban system, connecting South Bend with Indiana Harbor, an interurban system which will be unbroken from Buffalo to Chicago *via* Cleveland and Toledo will be in operation. Messrs. F. C. McMillan, of Cleveland, Ohio, and E. M. Bryson, of South Bend, Ind., are interested and guarantee that the branch from South Bend to Indiana Harbor will be constructed the coming year.

NEW LIGHTING CONCERN IN NEW JERSEY ORGANIZED BY PUBLIC SERVICE CORPORATION—The Middlesex Lighting Company has filed articles of incorporation, with an authorized capital stock of $100,000. This stock has been paid up by Albert B. Carlton, of Elizabeth, Frederick Evans, of New York, and Percy S. Young, of Passaic. The company is one of the subsidiary companies of the Public Service Corporation. The object of the new concern is to unite all the lighting plants in Middlesex County into one company.

LEHIGH TELEPHONE LINES—The Lehigh Valley Railroad Company is gradually installing an independent telephone system on its line, for the use of its officers in transacting business with each other, but not for train despatching. The line has been completed to Wilkesbarre, and the work of stringing wires from that point to Sayre will be finished in less than thirty days. The completion of the system from Jersey City to Buffalo will not be attained until 1906, and the installation is gradual in order that too much expense will not be involved in any one year.

MUNICIPAL POWER PLANT FOR BUENOS AYRES—The municipality of Buenos Ayres is considering a proposition to establish an electric light and power plant of its own. The plan proposed is that a company shall be organized with a capital of $18,000,000 (gold) to install a municipal power-house to supply light and power for all kinds of industries, exclusive privileges as to the laying of mains, etc., to be granted. By a system of amortization which would allow the company five and one-half per cent upon its capital it is figured that the plant would become the property of the municipality after a certain number of years.

POWER RATES FOR MONTREAL—The Montreal Street Railway Company has closed a contract for 4,000 additional horse-power from the Montreal Light, Heat and Power Company, which brings the amount of power used by the company to 9,000 horse-power. The new power will be delivered January 1. The power company has purchased the St. Lawrence Electric Company, the Canadian Electric Company, and the Provincial Electric Company. Announcement has been made that the company, so soon as its service was perfected, intended to reduce the rates on electricity in Montreal, notwithstanding the fact that the rates are lower now than in many other cities in America.

COMBINATION OF ELECTRIC AND STEAM ROADS—It is announced that plans are under consideration by the Erie Railroad Company, the Morristown & Erie Railroad Company and the Public Service Corporation of New Jersey to connect the city of Newark with Morristown by trolley. The Morristown & Erie company's tracks connect with the Erie Railroad Company's tracks at Essex Fells. The Morristown & Erie is the extension built from the terminus of the Erie Railroad at Essex Fells to Morristown, and has been recently opened for business. The plans are said to provide for the electrification of the Morristown & Erie so that trolley cars, as well as steam trains, can be operated over the line It is probable that the third-rail system will be adopted.

FOR A CABLE TO PANAMA—A bill has been introduced in the house of representatives, Washington, D. C., for a cable to connect the canal zone on the Isthmus of Panama with the United States. The bill, which is being forwarded by Representative Wanger, of Pennsylvania, provides for the construction and operation of such a cable, under the control and direction of the postmaster-general, the secretary of war and the secretary of the navy, the cable to be of American make and to be laid by American ships. The provision is made, however, that the cost of an American-made cable shall not exceed the cost of a foreign-made cable by more than ten per cent. The total cost of the cable is fixed at $2,000,000, and $300,000 is made available for its construction immediately.

NEWS NOTES FROM MEXICO—As soon as the necessary official authority is granted, the Mexican Telephone Company will install a central energy system and place its wires underground in the central portion of the city of Mexico. The Mexican government has entered into a contract with the Mexican Light and Power Company, Limited, for lighting the city of Mexico for ten years. The new contract provides for 1,200 arc lamps, to burn 4,000 hours annually. The city will pay the company $325,777 per year. An electric railway five kilometres long is being built to connect the large salt mines near Salina Cruz, Mexico, with Salina Cruz, in order to facilitate the shipment of salt over the National Tehauntepec railroad. Plans are under way for the installation of an electric light and power plant at Salamanca, in the state of Guanajuato.

ELECTRICITY ON THE NEW YORK CENTRAL—It is announced that the New York Central Railroad has reconsidered its intention to equip the New York & Harlem branch with electricity a year hence. It is said that the company will begin the work immediately and complete it as soon as possible. It is the purpose of the company to operate an electric suburban system between White Plains and the Grand Central station, and run the trains at a higher speed than is maintained at present. The tracks will have to be elevated or depressed both in West Mount Vernon and White Plains, where there are a number of grade crossings. Plans for this work are now being made. Work has already commenced at Glenwood-on-the-Hudson on a plant for the electric system between Yonkers and New York. The power plant for the Harlem branch will be located at White Plains.

MANITOBA POWER COMPANIES CONSOLIDATE—Announcement has been made that the Winnipeg General Power Company, which has been constructing a large electrical works on the Winni-

peg river, has amalgamated with the Winnipeg Electric Street Railway Company, under the name of the Winnipeg Electric Railway Company. This has been foreseen for some time, as it was known that the large shareholders of both companies were the same. The power works have been under construction for over two years. The power company has now in its employ over 600 men and the works are approaching the stage of completion, which enables the officials connected with the company to say that power will be delivered in Winnipeg in a large quantity, probably 15,000 horsepower, by next fall. The union of the two companies will result, it is understood, in a reduction of the rates for electric light and power very soon. The new company will operate the street railway system of Winnipeg, the gasworks on which it is at present spending half a million dollars, making it one of the most improved gasworks in America, also the commercial lighting and power business of Winnipeg. The present board of directors of the street railway company are the directors of the new company.

ENGINEERING SOCIETIES.

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The twelfth regular meeting of the Toronto branch of the American Institute of Electrical Engineers was held on December 9 at the Engineers' Club rooms, Toronto, Ontario. The subject for discussion was "Construction Work," which was introduced by Mr. C. H. Wright. Mr. R. T. MacKeen is secretary of the Toronto branch.

PHILADELPHIA SECTION OF THE AMERICAN ELECTROCHEMICAL SOCIETY—The Philadelphia section of the American Electrochemical Society held a regular meeting at the Hotel Markert, on Monday evening, December 5, and discussed the electrochemical papers read at the recent International Electrical Congress. The informal manner in which these meetings are conducted is found to add considerably to the interest and enjoyment of those in attendance.

PENNSYLVANIA STATE COLLEGE OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Pennsylvania State College branch of the American Institute of Electrical Engineers held a meeting on the evening of December 7. The paper by Messrs. Lyford and Smith, on "Problems of Heavy Electric Traction," was read and discussed. Following this a paper on "The Fire Risks of Transformers" was read. In addition there was discussion of a question box.

BOSTON BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—A meeting of the Boston branch of the American Institute of Electrical Engineers was held on the evening of December 7 at the Massachusetts Institute of Technology. Mr. Richard Fleming presided. After reading and approval of the minutes, a paper by Messrs. Lyford and Smith, on "Problems of Heavy Electric Traction," was reviewed and discussed by Mr. J. T. Vaughn. This is the paper which was read at the recent meeting of the Institute in New York. Mr. Vaughn's discussion was followed by Messrs. M. V. Ayers and J. B. Blood. Mr. G. H. Stickney is secretary of the Boston branch.

SCHENECTADY BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—A meeting of the Schenectady branch of the American Institute of Electrical Engineers was held on December 14. The subject of the meeting was "Electric Railways." It has been decided to hold meetings regularly on the second Wednesday in the month, and, in general, to have some subject of particular local interest for discussion. Among other topics to be taken up are "Western Transmission Systems," "Surges and Lightning Phenomena," "High-Potential, Long-Distance Transmission," "Regulation of Alternators," and Electrochemistry." All of these meetings will be held in Silliman Hall, Union College.

ORGANIZATION OF THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS—This society was organized December 5, 1904, at the rooms of the American Society of Mechanical Engineers, New York city. A preliminary meeting was held April 2, 1904, at the same place, to report on the form of a constitution and scheme of the society. At the meeting of December 5, of which John E. Starr was temporary chairman, two sessions were held. At the morning session the subject of the constitution and by-laws was taken up, and a constitution and by-laws founded on those of the American Society of Mechanical Engineers were adopted. There are three classes of membership: any person is eligible for full membership who is able to design and construct refrigerating machinery; any person who can operate refrigerating machinery is eligible to associate membership, and any one who is interested in refrigerating machinery is eligible to junior membership. A nominating committee was also appointed at this session. At the evening session the following officers were elected: president, John E. Starr; first vice-president, P. DeC. Ball; second vice-president, H. B. Roelker; treasurer, William C. Reed. The following gentlemen were elected governors: W. E. Parsons, Henry Torrence, Jr., E. L. Phillips, D. C. Jacobus, L. H. Jenks, Louis Block, Edgar Penny, W. T. Robinson, Thomas Shipley. A motion was passed empowering the board of governors to have the association incorporated. As there was no regular programme before the society at this meeting, Mr. Vories was asked to start a discussion on "The Unit for Measuring the Capacity of Refrigerating Machines." The discussion was taken part in by nearly every one present. A motion was afterward passed empowering the president to appoint a committee of five to cooperate with similar committees from other societies in recommending a suitable unit for the performance of refrigerating machinery. A collation was served, after the meeting adjourned.

LEGAL NOTE.

WESTERN UNION LOSES IN PENNSYLVANIA SUIT—The Supreme Court of the United States decided on December 12 the case of the Western Union Telegraph Company *versus* the Pennsylvania Railroad Company, involving the right of the railroad company to remove the telegraph company's poles from its right of way, in favor of the railroad company. The opinion was handed down by Justice McKenna. In this decision the court held that the congressional act of 1866, which controlled in the case, does not grant eminent domain to telegraph companies over the private property of railroad companies. Justice Harlan delivered a dissenting opinion, holding that the act of 1866 gives to telegraph companies the unequivocal right to construct and operate lines, not only upon the public domain, but along any post-road of the United States, and he contended that if the decision, as rendered, was to stand, the United States government could not itself enter upon the rights of way of railroad companies. The Supreme Court also decided the case of the Western Union Telegraph Company *versus* the Pennsylvania Railroad Company, involving the right of the telegraph company to condemn a part of the railroad's right of way in western Pennsylvania and appropriate it for its lines. The decision was against the telegraph company.

OBITUARY NOTICES.

MR. CHARLES B. RITCHIE, secretary of the Ritchie Electric Company, Camden, N. J., was drowned on Wednesday, December 7, in the Delaware river. Mr. Ritchie made a misstep in attempting to board a yacht and plunged overboard.

MR. HEINRICH WELLMAN, president of the Oregon & Washington Electric Power Company, died suddenly at Oakland, Cal., November 25. The company of which he was the head is promoting the construction of an electric line from Pendleton, through Walla Walla, to Dayton, in the state of Washington.

ALBERT COOPER WARD, son of George Gray Ward, vice-president of the Commercial Cable Company, died at his father's home, 51 West Fifty-third street, New York city, December 9, from pneumonia, after an illness of only twenty-four hours. He was twenty-three years old and was graduated from the Sheffield Scientific School, Yale University, in 1904. He was a member of the brokerage firm of Keen & Ward. His engagement to Miss Beatrice Squire, of Greenwich, Ct., had been announced. He was a member of the Yale Club and the Chi Phi fraternity. The funeral was held Sunday afternoon at two o'clock from the Church of the Heavenly Rest, Fifth avenue and Forty-fifth street.

PERSONAL MENTION.

DR. SVANTE ARRHENIUS, professor of physics at the University of Stockholm, Sweden, has been called to the University of Berlin.

DR. OTTO LUMBER, of the staff of the Physikalischer Technischer Reichsanstalt, has been made professor of physics at the University of Breslau, Germany.

MR. H. C. FUHR has been appointed assistant superintendent of the Ohio Valley Telephone Company, and will have charge of installing the new system in Wheeling, W. Va.

DR. WALTHER NERNST, professor of physics and chemistry at University of Gottingen, has been made director of the Physikalischer Technischer Reichsanstalt, Charlottenburg, Germany.

MR. P. F. KOBBE has resigned as third vice-president of the Westinghouse Electric and Manufacturing Company on account of ill health. He has been succeeded by L. A. Osborne, who has been fourth vice-president, Newcomb Carlton becoming fourth vice-president. Mr. Kobbe will continue a director of the company.

MR. W. J. SANDO is one of the recent additions to the new organization of the Allis-Chalmers Company. He has been appointed manager of the company's pumping machinery department, with headquarters at Milwaukee, Wis. Although still a young man Mr. Sando has filled many responsible places, both in public and private employ, before joining the Allis-Chalmers forces. His last public service was with the New York city commission on additional water supply, with which he served from May 1, 1903, to January 1, 1904, as engineer in charge of the pumping department. Mr. Sando is one of those who have risen to high rank through the practical school, rather than the academic. He was born in Scranton, Pa., in 1864. He received a public school education and served an apprenticeship of five years in the works of the Dickson Manufacturing Company at Scranton. This employment was followed with another apprenticeship of two years in the draughting room. Thus equipped, he became, in 1886, draughtsman and inspector of pumping machinery for E. D. Leavitt, M. E., with whom he remained until August, 1889. In September of that year he entered the government service as draughtsman-in-charge in the office of the naval engineers at the shipyards of William Cramp & Sons, Philadelphia. He returned to Mr. Leavitt in the following spring and remained with him seven years, or until May, 1897, when he resigned to become associated with the Metropolitan Water Board, of Boston, Mass., where he remained from June, 1897, to September, 1900, holding first the place of inspector of pumping machinery, and later becoming mechanical engineer and superintendent in charge of pumping stations. In September, 1900, Mr. Sando joined the International Steam Pump Company as chief engineer and manager of its waterworks department. He remained with this company until his appointment with the New York city commission, as above noted. In January, 1904, he rejoined the International Steam Pump Company, and was with that concern until a little while before he took charge of the pumping department of the Allis-Chalmers Company. Mr. Sando has made a special study of the cost of pumping water for municipalities and has published several articles upon the subject. His acquaintance among waterworks engineers and superintendents is very wide, and the fact that he was employed and reemployed by public commissions and private parties prominent in waterworks enterprises is the best evidence of his high standing in his profession. He is a member of the American Society of Mechanical Engineers, the Boston Society of Civil Engineers, the New England Waterworks Association, American Waterworks Association, New York Electrical Society, Boston Society of Art, American Association for the Advancement of Science, and the Engineers' Club, of New York.

EDUCATIONAL.

NEWARK TECHNICAL SCHOOL—A handbook of information of the Newark Technical School, describing the work planned for the year 1904-1905, has been received. Courses are given in mechanical drawing, architectural drawing, applied mechanics, technical chemistry, theoretical and applied electricity, electroplating, electric wiring, plumbing, and in design for jewelers and silversmiths.

ELECTRICAL SECURITIES.

Although talked of for some time and apparently anticipated by all observing parties interested in stock market movements, the big break in prices which occurred during the week ending December 10 came more or less in the form of a surprise. The surprise was even more acute when the slump went further than has been prophesied by those most sanguine of a decline. Breaks in prices of leading securities varying from five to twelve points brought out a condition of semi-panic, but this, fortunately, lasted only for but one day. Almost as sensational as the decline was the rapid recovery of the stocks which apparently had gone to pieces the day before. Taking the whole week under consideration the net changes are surprisingly small. In some issues there are even advances to be shown. The rapidity and extent of recovery gives indication that powerful interests still think that the general price tendency should be upward. There are those in the market—and their number is large—who believe that the general outlook is so strong that it will not be long before the stock market is again discounting the future.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 10.

New York:	*Closing.*
Brooklyn Rapid Transit	63
Consolidated Gas	209
General Electric	189
Interborough Rapid Transit	163¾
Kings County Electric	202
Manhattan Elevated	165
Metropolitan Street Railway	129½
New York & New Jersey Telephone	165
Westinghouse Manufacturing Company	190

The General Electric Company has declared the regular quarterly dividend of 2 per cent payable January 14 to stockholders of record December 17.

The regular quarterly dividend of 1¾ per cent will be paid on the stock of the Metropolitan Street Railway Company January 16. Books will close December 23 and reopen January 17. At the annual meeting of the company's stockholders R. A. C. Smith was elected a director to fill the vacancy in the board. Other business was merely routine.

Boston:	*Closing.*
American Telephone and Telegraph	146
Edison Electric Illuminating	252
Massachusetts Electric	62
New England Telephone	136
Western Telephone and Telegraph preferred	99

The gross earnings of the Boston Elevated system for the year ending September 30, 1904, show a gain over those of the previous year of only 3½ per cent, which is considerably below the normal percentage of gain. In the previous year the gross earnings increased 5.6 per cent over those of 1901-1902. Net earnings show an even smaller gain, amounting to 1.6 per cent. The number of passengers carried was 241,681,945, an increase over the preceding year of but 3.4 per cent. This is the smallest percentage of increase since 1897.

Philadelphia:	*Closing.*
Electric Company of America	10⅛
Electric Storage Battery common	81
Electric Storage Battery preferred	81
Philadelphia Electric	10
Philadelphia Rapid Transit	17
United Gas Improvement	106¼
Chicago:	*Closing.*
Chicago Telephone	146
Chicago Edison Light	170
Metropolitan Elevated preferred	67
National Carbon common	43
National Carbon preferred	109¾
Union Traction common	12½
Union Traction preferred	43

Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent, payable December 30. Books close December 26 and reopen December 31. The November gain in telephones is 1,604, a total in use of 116,626. It is stated that the company is preparing to issue additional stock for the purpose of extending the business. Since January 9 $9,000,000 in new stock has been issued, making a total of $14,000,000 of the $20,000,000 authorized capital stock.

NEW INCORPORATIONS.

DES MOINES, IOWA—Solon Telephone Company. $900.

LINCOLN, NEB.—The Jansen Telephone Company. $10,000.

WOODLAKE, MINN.—Woodlake Rural Telephone Company. $30,000.

MADISON, WIS.—Belmont & Pleasant View Telephone Company. $5,000.

TRENTON, N. J.—The Jersey Central Traction Company. Increased from $1,000,000 to $1,500,000.

MILWAUKEE, WIS.—Valley Telephone and Telegraph Company. Increased from $200,000 to $250,000.

PORTLAND, ME.—Fort Fairfield Electric Company. $40,000. Incorporators: H. L. Cram, A. J. Desmond, Frederick Hale.

JACKSON, MICH.—Henrietta Central Telephone Company. $550. Directors: T. J. Spears, Jerry Turner and Allis White.

KOKOMO, IND.—Kokomo Electric Company. $10,000. Incorporators: George Kingston, John W. Johnston, Edward S. Huff.

HUMBLE, TEX.—Humble Electric Company. $30,000. Incorporators: J. C. Wilson, F. A. Peters, F. D. Lyon, all of Houston.

BLUFFTON, IND.—Interstate Traction Company. $150,000. Incorporators: Frank M. Caldwell, Fred M. Caldwell and Fred J. Speyer.

LITTLE ROCK, ARK.—Bearden Telephone Company. $2,000. Incorporators: William M. Gatling, Jeff Dittling and William M. Gatling, Jr.

MATTHEWS, IND.—Matthews Electric Light and Power Company. $15,000. Directors: Philip Hughes, Guy S. S. Renebolt, Everett W. Trook.

LAKETOWN, IND.—Disco & Laketown Telephone Company. $15,000. Directors: Frank J. Zimmerman, Edwin L. Harmon, Harmon C. John.

HENNESSEY, OKLA.—Center Township Rural Telephone Company. $1,000. Incorporators: Frank Hassler, of Dover; Ben Thorne, William Beaman and others, of Hennessey.

HUNTSVILLE, ALA.—Intercounty Telephone Company. To install a rural system, which will later be extended to Decatur, Hartselle, Cullman and other towns. $2,000.

SPRINGFIELD, OHIO—Springfield Construction Company. Organized for the purpose of railroad construction in connection with the Springfield, South Charleston, Washington & Chillicothe Traction Company. $100,000. Incorporators: John Snyder and others.

ALBANY, N. Y.—Queens-Nassau Electric Light and Power Company. To supply gas and electricity in the counties of New York, Nassau, Queens, Kings, Suffolk, Richmond and Westchester. $100,000. Directors: G. F. Swinnerton, of New York city; A. Foshay and R. K. Thompson, of Brooklyn.

SPRINGFIELD, ILL.—Alton, Jacksonville & Peoria Railway Company. To be constructed from Alton to Peoria, with branch lines from Alton to Grafton, Jerseyville, to Hardin and Jerseyville, to Carlinville. $10,000. Incorporators and first board of directors: Robert Curdie, Alton; Joseph W. Becker, Joseph M. Page, John C. McGrath and Aaron O. Auten, of Jerseyville.

ALBANY, N. Y.—Interborough Telegraph and Telephone Company. To operate between Philadelphia, Trenton, N. J., New York city and Orient Point, L. I., and from New York to Montreal. $100,000. Directors: Howard K. Wood, Horace S. Gould, Otho S. Lee, Jr., Charles S. McCredy and Ten Eyck Remsen Beardsley, of New York, and Robert G. Martin, of Brooklyn.

TELEPHONE AND TELEGRAPH.

LITTLE FALLS, N. Y.—The Interstate Telephone Company has completed connections with Albany.

WATTSBURG, PA.—The Mutual Telephone Company is at work on a line from Arbuckle to Wattsburg.

COLUMBIA, PA.—The Columbia Telephone Company is rebuilding the line between here and Donerville.

SOUTH BEND, IND.—The Postal Telegraph-Cable Company will shortly place its circuits in this city underground.

FOREST DEPOT, VA.—The construction of the telephone line from Coffee *via* Perrowville to Forest is now under way.

ALEXANDRIA, LA.—The Cumberland company has begun the construction of toll lines between New Orleans and Shreveport.

MULLIKEN, MICH.—The Citizens' Telephone Company, of Grand Rapids, is hastening its line between Lake Odessa and Grand Ledge.

ELDON, IOWA—The Eldon Telephone Company contemplates a number of improvements to its system, including considerable cable work.

BEATRICE, NEB.—Fifteen farmers living west of Pickerell and who are patrons of the Home Telephone Company have organized a farmers' exchange.

CLEVELAND, OHIO—The Bell Telephone Company has opened a new branch exchange at the corner of Detroit and Marlow streets. This exchange serves about 300 subscribers.

FULTON, N. Y.—The Fulton Telephone Company is making arrangements for extensive improvements to its line. The company has about 300 telephones in operation at the present time.

BROOKLYN, N. Y.—Owing to the increased demand for its service the New York & New Jersey Telephone Company is stringing a number of additional wires in the vicinity of Greenport.

BELLINGHAM, WASH.—The stations on the Bellingham & Victoria Telephone line have been installed. There are five of these at Doe Bay, Orcas, East Sound, Shaw Island and Friday Harbor.

LINCOLN, NEB.—The village of Juniata has granted franchises to two telephone companies; one line, coming from Bladen, is called the Glenwood company, and the other is the Farmers' company of Adams county.

WATKINS, N. Y.—The Reading & Rock Stream Telephone and Telegraph Company will soon have direct connection with this village. This line extends from Rock Stream to Reading Center, Sugar Hill and Pine Grove.

YOUNGSTOWN, OHIO—The Bell Telephone Company has started the construction of an entirely new telephone line between this city and East Palestine, passing through the towns and villages of Leetonia, Columbiana and New Waterford.

PENN YAN, N. Y.—The Niver Telephone line from Hammondsport has been extended to Pulteney. The company has connection at Bath with the Century company, thus giving subscribers the benefit of the long-distance connections of that company, and the Inter-Ocean long-distance service.

HAASVILLE, LA.—Arrangements have been made and a part of the material is now on the ground for the building of a telephone line from Eola west to Black Lake and the village of Dossman, in St. Landry, thus connecting the above-mentioned places with the Lafayette branch of the Southern Pacific railroad.

BATTLE CREEK, MICH.—At the annual meeting of the Citizens' Telephone Company the following officers were elected: president, E. B. Fisher, Grand Rapids; vice-president, Lycurgus McCoy, Battle Creek; secretary and general manager, C. F. Tarte, Grand Rapids; treasurer, L. W. Robinson, Battle Creek.

ALTA, IOWA—At a special election the Alta Telephone Company was granted a franchise for twenty years. The company is composed of David E. Hadden and G. Frank Tincknell and is entirely owned by local capital. It now has 135 telephones in the town and 125 in the country, with fifty rural telephones to put in as soon as supplies can be secured.

ALTOONA, PA.—The United Telephone and Telegraph Company is planning extensive improvements to its lines in and around this city. The company will extend its telephone lines through the neighboring rural districts and establish communication between this city and a number of other towns. The new line from Eldorado to Lilly, connecting with Altoona, has been begun and a new toll line will be put in between this city and Johnstown in the near future.

ELECTRIC LIGHTING.

YOUNG AMERICA, MINN.—H. Perschon will install a 500-light plant

GAYLORD, MICH.—The electric plant here was gutted by fire November 14.

CLARKSVILLE, IOWA—The electric light plant has been sold to Willis Sutcliffe.

CALGARY, ONTARIO—This city has decided to invest $60,000 in an electric plant.

PIERCE, NEB.—M. H. Henzler and Herbert Craven have been granted a franchise for an electric light plant.

EDGAR, NEB.—The city council has granted a franchise to Keefe & Larkin for lighting the city by electricity.

LEON, IOWA—The town has voted to sell the electric light plant to W. S. Curtis and H. E. Chase, who will make many improvements to it.

MONTREAL, CANADA—The town of Westmount has decided by a vote of 446 to 11 in favor of municipal ownership for its electric light and incineration plant.

KNOXVILLE, TENN.—The Knoxville Electric Light Company is stringing a line of wires in South Knoxville along the Sevierville pike for a distance of two miles, to the terminal of the new street car line.

ST. THOMAS, ONT.—The experts engaged in the valuation of the gas, electric light and power plant of the St. Thomas Gas and Electric Light Company have set a price of $196,366.38 to be paid by the city.

GOLDENDALE, WASH.—The city council of Goldendale has granted an electric light franchise to R. T. Robinson for a term of twenty years, and entered into contract for street lighting during the next two years.

SALEM, MASS.—The annual report of the Salem Electric Lighting Company, as filed with the state board of gas and electric light commissioners, shows assets of $377,977.91 and liabilities of $369,452.84, leaving a surplus of $8,525.07.

BALTIMORE, MD.—A contract has been awarded by the Maryland Telephone and Telegraph Company for the erection of two stacks for its big electric light and power plant in South Baltimore. One of these stacks will be 200 feet high, and the other 150 feet.

PORT WASHINGTON, N. Y.—The Nassau Light and Power Company's revised bid for lighting the streets of North Hempstead town has been accepted by the town board. The new rate is $20 per year for each twenty-candle-power incandescent light used. The contract is for one year.

CUMBERLAND, MD.—The Harper's Ferry Electric Light Company is making preparations to supply the town of Brunswick, six miles down the Potomac river with light. The supply wire from Harper's Ferry to Brunswick will be erected on the Chesapeake & Potomac telephone poles.

ALBION, N. Y.—The electric current from the Waterport power-house of the Albion Electric Light, Power and Gas Company, north of this village, has been turned on and is now supplying power and light for the village of Brockport. The current travels a distance of about twenty-five miles.

NEW LONDON, CT.—The following officers were elected at the recent annual meeting of the New London Gas and Electric Company: president, James Hislop; vice-president, Billings P. Learned; directors, Billings P. Learned, Frank B. Brandegee, William H. Warner, of Branford.

DALLAS, GA.—The citizens of the town have organized a corporation known as the Dallas Light and Power Company. A. J. Cooper was made president and E. H. Robinson secretary and treasurer of the new company. It is proposed to erect the electric plant first and then waterworks. Five thousand dollars was subscribed.

CARTHAGE, N. Y.—Papers have been forwarded to the secretary of state for the Harrisville Electric Light Company. The incorporators named are Thomas J. Wilber, Joseph Weeks, Sr., J. E. Harney, D. J. Culver and D. F. Sprague. The purpose of the company is to furnish power and light for the people and village of Harrisville.

WINCHESTER, VA.—The city council has entered into a one-year contract with the Winchester Gas and Electric Light Company at the advanced rate of $70 per light. The city council has taken the initiatory steps for the establishment of a municipal plant, which will, however, require more than a year to complete, as the necessary funds are not now available.

OKLAHOMA CITY, OKLA.—The Shawnee Light and Power Company, of which J. J. Henry, who was until recently interested in Oklahoma City, was president and treasurer, has passed into the hands of a receiver, J. C. Fisher being named by the court at Tecumseh. This action was based upon the application of J. H. Draughton, who sold the plant to Henry.

OXNARD, CAL.—The Oxnard Light and Water Company has purchased a tract having a frontage of 200 feet on Sixth street near the Southern Pacific station, and will build a large brick power-house for a new and up-to-date lighting plant. A 200-horse-power heavy-duty engine has been ordered, with boiler plant, dynamos, etc., and work will be commenced immediately. The company has heretofore purchased its electric current.

JEFFERSON CITY, MO.—In the special election on the granting of a twenty-year franchise to a Chicago syndicate to furnish electric and gas light to the city, the proposition carried by a vote of 863 to 68. This ratifies the sale of the plant to the Chicago people, the consideration being $100,000. The terms of the franchise make it incumbent upon the new company to improve the service and reduce the schedule of prices which has prevailed.

LA GRANDE, ORE.—The La Grande Electric Company has consolidated with the Cove Power Company, and they have incorporated under the name of the Grand Ronde Electric Company. The directors are Walter Pierce, J. A. Thornson, T. H. and Clarence Crawford and T. R. Berry. The power will be used for an electric line which will reach this city by June 1. This line will connect Cove, Union, Hot Lake, La Grande and possibly the other towns in Union County.

TROY, N. Y.—The Hudson River Water Power Company is installing the sixth generator of the same type as the ones in operation at the power-house at Spier falls. In order to operate this machine it is necessary to build another temporary bulkhead at the end of the intake canal, and tear out the ones which shuts off the water at the end of the fifth flume. Work on the permanent power-house is progressing as rapidly as possible, and it is expected that half of the structure will be finished and enclosed shortly.

HAMILTON, ONT.—The Cataract Power Company has put in operation part of its new plant at DeCew falls. Two of the four new generators have been started up, with the result that the supply of power coming to the city has been increased by 34,400 horse-power. This means that the company now has available for use here and elsewhere along its lines 20,500 horse-power. The other two generators will not be placed in commission before May of next year. These will give an additional 13,400 horse-power.

SACRAMENTO, CAL.—The Bay Counties Power Company has entered into a contract with the Burrell Construction Company for the construction of two towers for running wires across the Sacramento river. One of these towers is to be erected in Washington, Yolo County, and the other in this city. The Bay Counties Power Company proposes to bring another power line into this city, which will connect with its line at Davisville. The object is to give Sacramento better electric service, and to ensure power at all times.

ST. ALBANS, VT.—The electric power from Fairfax falls has been turned on to this city. It is estimated that 2,250 horse-power will be developed at the power plant even at the time of minimum water supply so that this power will be always available. But 120 horse-power is required to operate the street lights in this city at present and after all the power that is required at present in this city is furnished there will be some 2,000 unutilized horse-power. The Vermont Power and Manufacturing Company, whose stock is

owned principally in Philadelphia, Pa., and Pittsfield, Mass., was formed for the purpose of buying the Fairfax falls and installing an electric power plant there. Its officers are: president, C. C. Chesney, of Pittsfield, Mass.; vice-president, George M. Bunting, of Philadelphia; secretary, H. Bayard Hodge, of Philadelphia; general manager and treasurer, W. H. Vorce, of St. Albans. The plant cost $125,000.

YANKTON, S. D.—Articles of incorporation have been granted to the Yankton Improvement Company, capital stock $100,000, with Israel Piles, William S. Stockwell, Sanford G. Donaldson and Michael Magner as incorporators. The company will apply to the city council for a franchise to build and operate an electric light and gas plant in the city of Yankton. The plant will be of sufficient size to furnish heat as well as light to business blocks and private residences all over the city. A new system of arc lighting for the city is also planned.

NEWARK, N. J.—Philip N. Jackson has obtained control, through foreclosure, of the Orange County Gas and Electric Company, of Middletown, N. Y., and is reorganizing the corporation, with a view to assuming its active management. The company, in which Mr. Jackson is a heavy bondholder, and in which he had at one time previously a controlling interest, has an authorized capital of $300,000 and a bond issue of the same amount. Of the bonds, $100,000 was to pay for an underlying issue, and $114,000 were issued. Of the capital $200,000 was paid in.

GADSDEN, ALA.—Articles of incorporation of the Etowah Light and Power Company, of Attalla, have been filed. The company is capitalized at $24,000, with A. L. DuPre, of Attalla, as president, J. R. Brown, of Attalla, as vice-president, and Adolphus Brown, of Ragland, as secretary and general manager. It has purchased the water power of W. P. Lay on Wills creek and has the contract for lighting the town of Attalla. The company will also furnish lights for private residences, and motive power for the operation of small manufacturing plants.

NEWARK, N. J.—The Middlesex Lighting Company has had articles of incorporation recorded. Its objects are set forth to be "to manufacture, buy, sell, accumulate, store, transmit, furnish and distribute electric current for light, heat and power." It has also the right to manufacture the necessary machinery for the same, erect poles, string wires and do a general business of electrical and mechanical engineers. There is an authorized capital stock of $100,000, and this has all been paid up by Albert B. Carlton, of Elizabeth, one of the vice-presidents of the Public Service Corporation, Frederick Evans, of New York, its secretary.

SCRANTON, PA.—A mortgage for $400,000 has been filed in the office of the recorder of deeds by the Suburban Electric Light Company. It is drawn in favor of the Title Guaranty and Trust Company, and is made payable in thirty years with five per cent interest. The mortgage is for the purpose of securing money with which to carry on contemplated improvements. The loan was authorized at a meeting of the company September 29, last. Among the improvements is the erection of the new plant on Washington avenue, which is now almost completed. A large quantity of electrical apparatus is to be installed, and the system is to be generally improved.

STERLING, ILL.—A license for a charter has been granted at Springfield to the Morrison Power Company, of Morrison, Ill., in compliance with a petition signed by H. S. Green, Edward A. Smith and George A. Whitcomb, all citizens and business men of Morrison. This company was organized some time ago for the purpose of building a dam across Rock river at Lyndon for the purpose of securing water power for the generating of electricity. The company has already done a great deal of preliminary work. It now owns five acres of land on one side of the river and four on the other. The plans for its dam are practically completed, and the indications are that actual work will be started early in the spring. The concern, it is understood, is backed by all of the capital necessary. The dam and power plant will cost in the neighborhood of one hundred thousand dollars. The purpose of the company is to furnish electric power for manufacturing purposes. One of its principal fields will be Morrison, eight miles from Lyndon.

ELECTRIC RAILWAYS.

SOUTH HAVEN, MICH.—Work has commenced on an electric road which will run in and around South Haven.

FORT SMITH, ARK.—The Fort Smith Electric Railway Company has planned improvements on the road to cost $280,000.

VINTON, IOWA—The Belle Plaine & Vinton street and interurban line proposes a line to this city. Preliminary surveys have been made.

MORGANTOWN, PA.—Residents of this place are agitating the subject of a trolley line to connect with the line at Blue Ball and to extend to Birdsboro *via* Joanna.

HATTIESBURG, MISS.—A street railway franchise has been granted to G. L. Hawkins and associates by the city council. Work is to be commenced by the first of June.

SPRINGFIELD, OHIO—The county commissioners have granted a franchise to the Chillicothe Traction Company to construct its line east of South Charleston to the Madison County line.

LIMA, OHIO—The Western Ohio Railroad Company has commenced the laying of track along the right of way between this city and Lima. The right of way has not all been secured as yet.

CLAYTON, N. J.—The trolley extension from Woodbury to Clayton now seems assured. The road has been surveyed by the way of Glassboro, Pitman and Bansboro and arrangements are being made to get the necessary franchises.

TERRE HAUTE, IND.—The Terre Haute Traction Company has begun buying right of way for an interurban line to Paris, Ill. The route will be through Sanford, Ind., and Vermillion, Ill., and the distance twenty miles. It is said the work of construction will begin next spring.

KANKAKEE, ILL.—The Chicago & Southern Traction Company held a meeting in Chicago recently and elected the following officers: William S. Reed, president; Attorney Charles F. Davies, vice-president and general counsel; John B. Reed, secretary, and Robert P. Woods, of Indianapolis, treasurer.

SOUTH McALESTER, I. T.—The city council of Hartshorne has granted a franchise to the Indian Territory Traction Company to build its line through the business portion of the town. The line will be completed and ready for business from South McAlester to Hartshorne by January 1.

ROCKVILLE, CT.—The contract for the construction of the Rockville, Broadbrook & East Windsor street railway, which it is proposed to run from this city through Ellington and Broad Brook to connect with the Hartford & Springfield street railway beyond that village, has been taken by Thomas C. Perkins, of Hartford.

WABASH, IND.—The Fort Wayne & Springfield Traction Company has filed a mortgage in the four counties through which it passes to secure a $300,000 issue of five per cent bonds. The line is rapidly approaching completion, and many of the bridges projected from Fort Wayne, Ind., to Springfield, Ohio, have been got under way.

SUFFOLK, VA.—The town council has sold to the Seaboard Traction Company a franchise granting the use of certain streets for an electric railway. The Seaboard Traction Company is planning to run an electric trolley line from Norfolk to Richmond, and desires besides to use Suffolk streets for local traffic. There were no other bidders.

KENDALLVILLE, IND.—F. E. Seagraves, who constructed the electric lines between Toledo and Fayette, Ohio, and between Toledo and Adrian, Mich., expects the early financing of his proposed line from Toledo to this city. The line is to be known as the Toledo & Western, and would be one of a chain of electric lines connecting Chicago and Cleveland.

NEW HAVEN, CT.—At the approaching session of the Connecticut legislature trolley charters will be asked for paralleling two lines of steam road leaving this city on the east, *viz.:* the Air Line and the Shore Line railroads. Along the former the proposed trolley will run from here to Middletown, to Willimantic, to Putnam and thence to Boston. There will be fully seventy miles of construction on this route. On the Shore Line the road will have

to be built east from Branford to East Lynne, and from near Westerly, R. I., to Providence. Fifty miles of trolley will have to be constructed on this route.

KALAMAZOO, MICH.—A franchise for a street railway has been granted by the city council of Coldwater to the Toledo & Michigan Electric Railroad. The company proposes to construct an interurban line from Toledo to Coldwater, and guarantees to have at least six miles of interurban track adjoining the city limits completed before beginning construction work within the city.

COLUMBIA, S. C.—A commission has been issued by the secretary of state to the Charleston & Summerville Railway Company, with a capital stock of $1,000,000, which purposes constructing an electric railway line between Charleston and Summerville. The incorporators named in the commission are J. J. O'Connell, George S. Legare and R. P. Evans, of Charleston, and Warren F. Martin, of Philadelphia.

PITTSBURG, PA.—According to the statements of those interested in the construction of the new trolley road from Library to Washington, Pa., which is under the active promotion of ex-Senator William Finn, the work on that line is to be started early next spring. The new line is over a private right of way and will be built for a double-track road, but with only one track laid at the start.

HOUSTON, MO.—The Houston, Licking & Salem Electric Railway Company has been organized here with the following board of directors: James A. Craven, Robert Lamar, W. J. McGehee, Clark Dooley, W. E. Barton, J. R. Blankenship and A. J. Johnson. Bonds will be issued soon and placed on the market. It is believed that the enterprise is assured, and that an electric road will be built from Houston to Salem, *via* Licking.

YPSILANTI, MICH.—The survey of the Adrian & Ann Arbor electric railroad, which is to run through Mason and Tecumseh, has been completed. The company has secured the right of way and the partly completed grade of the Berry line, an abandoned extension of the Detroit & Eel River railroad from Logansport, Ind., to Detroit. If the weather permits the construction of the line will be begun this winter.

NEWARK, N. J.—At a public meeting in the Assembly Hall, Springfield, the township committee granted the Morris County Traction Company a franchise to lay double tracks. The road will run along the centre line of Main street from Morris avenue to the dividing line between the townships of Springfield and Millburn, thence from the city line of Summit to the centre of the Rahway river, the dividing line between Springfield and Union townships.

COLUMBUS, OHIO—The Cleveland, Wooster, Mount Vernon & Columbus Railroad Company, of Mount Vernon, has been incorporated with $10,000 capital stock by John J. Vail, James B. Graham, James A. Tillen, Fred W. Jones and E. F. Shelley. They propose to build an electric railway connecting Cleveland and Columbus, through Cuyahoga, Medina, Summit, Wayne, Stark, Holmes, Ashland, Crawford, Richland, Knox, Licking and Franklin counties.

HUNTINGDON, PA.—It has been announced that Huntingdon is to have its first trolley system. Edward G. Jones is at the head of the movement, and he has associated with himself capitalists from Johnstown, Scranton and Lancaster. A company with a capitalization of $180,000 has been organized. The route as laid out will cover the main streets of the town and extend to Mapleton and Alexandria, west. Huntingdon will be the centre of a thirty-mile system.

WATERLOO, IOWA—Two new electric lines will in all probability be constructed into Waterloo during the coming building season. One is the extension of the Smith Dows line from Iowa City to Cedar Rapids on to Waterloo. The other is the line that was proposed last summer from Marshalltown to this city. The Waterloo, Cedar Falls & Northern Railway is also planning an extension of its line from Summer to West Union, a distance of over thirty miles.

SANTA FE, N. M.—By a trust deed filed in the office of the probate clerk of Santa Fe County the Albuquerque Eastern Railroad Company, now constructing a line from Moriarity, on the Santa Fe Central, to Albuquerque, mortgages its property, franchise and equipment to the Pittsburg Trust Company, of Pittsburg, which in turn furnishes the capital for the enterprise. W. H. Andrews is president of the Albuquerque Eastern and W. S. Hopewell is general manager.

ATLANTA, GA.—At a meeting of the stockholders of the Atlanta & Carolina Railway Company the organization of the company was perfected by the election of officers and directors. The company proposes to build an electric line from Atlanta to Greenville, S. C., which it is expected eventually will give Atlanta a direct line to the Atlantic seaboard. The capital was raised from $50,000 to $200,000, and arrangements were made for the speedy beginning of active construction. John R. Hasch, of Haschton, S. C., was elected president.

PENDLETON, ORE.—The scheme to connect Pendleton with Walla Walla by an electric line is again being agitated. A company is to be organized by capitalists of Pendleton and Walla Walla with a capitalization of $250,000. The promoters will retain half of the stock and plan to place the remaining $125,000 on the market. Behind the scheme are chief stockholders in the Washington & Oregon Power Company, which is installing a plant on the Little Walla Walla river, in this county, to supply Pendleton, Walla Walla and the intermediate towns with electrical power.

NEW MANUFACTURING INTERESTS.

PITTSBURG, PA.—The C. K. Hill Electric Company has been organized with a capital of $50,000.

PORTLAND, ME.—The Kinney Electric Light Display Company, with a capital of $1,000,000, has been incorporated by M. W. Baldwin and G. C. Knight.

CHICAGO, ILL.—The Pierce Specialty Company has been formed to manufacture electrical goods. E. J. Finn and M. J. Thompson are the incorporators, and the capital is $50,000.

ROCHESTER, N. Y.—The Babcock Electrical Company has been incorporated with a capital of $50,000. Garrison Babcock, J. L. Hotchkiss and C. T. Chapin, of Rochester, are directors.

BINGHAMTON, N. Y.—The Tray Plate Battery Company has been incorporated with a capital of $50,000. The directors are: E. A. Beman, A. C. Rahe and G. C. Bayless, of Binghamton.

SYCAMORE, ILL.—The Selective Signal and Telephone Manufacturing Company has been formed by James C. Joslyn, Edward F. Buell and Charles A. Bishop. The capital stock is $100,000.

GUTHRIE, OKLA.—The Banner Electric and Manufacturing Company, of Oklahoma City, has been incorporated by Charles Luck, Charles Risdon and Warren Snyder. The capital is $10,000.

COLUMBUS, OHIO—The Barkelew Electric Company, of Middletown, Ohio, has been incorporated by C. H., C. S., R. T. and E. W. Barkelew, for the purpose of making electrical devices. The capital is $15,000.

ROCHESTER, N. Y.—C. D. Rolfe, John D. Lynn and Smith O'Brien, of Rochester, have organized the Elfor Electric Company. The company is capitalized at $10,000, and will deal in machinery and supplies.

ALBANY, N. Y.—The Lewis S. Davis Electrical Construction Company, of New York city, has been incorporated with a capital of $500. The directors are John Davis, E. M. Davis and R. W. Davis, of New York.

LOS ANGELES, CAL.—The United States Electric Manufacturing Company has incorporated with a capital of $5,000, fully subscribed. The directors are: C. Maxstadt, Francis W. Maxstadt, I. J. Francis, L. A. Lovell and A. M. Graham, all of Los Angeles.

ALLIANCE, OHIO—The Electric Filter Company has been sold, and will be moved from Youngstown to Alliance. The company has been reorganized and the following directors elected: J. S. Spring, Jesse M. Rice, H. E. Kilmer, of Alliance, and Edward Hartsuff and William McConahy, of Newcastle, Pa. The capital stock has been increased from $10,000 to $30,000.

COVINGTON, LA.—The Southern Electrical Manufacturing Company has been incorporated with a capital of $200,000, and the following officers: E. Y. Ames, of Covington, president; Arnold Heller, of New York city, vice-president, and E. J. Frederick, of Covington, secretary-treasurer. The company has secured control of all the patents on the Simplex arc light, and will manufacture the lamps in this city.

INDUSTRIAL ITEMS.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., is calling attention to plumbago-laid Manila rope. This rope is designated as the "Stevedore," and is used for the transmission of power and hoisting cargo. The material is described in pamphlet No. 1414. This pamphlet will be sent upon request.

THE DENVER GAS AND ELECTRIC COMPANY, Denver, Col., is carrying out an elaborate system of publicity. The Denver company keeps in touch with its patrons and all prospective users of electric power with a series of illustrated mailing cards, through guessing contests, and by way of numerous other attractive features for holding the public notice.

THE COOPER HEWITT ELECTRIC COMPANY, 220 West Twenty-ninth street, New York city, is distributing a general price list, supplementing its illustrated descriptive catalogue. This price list includes quotations on mercury-vapor lamps for general illumination, photography, photoengraving, blue-printing outfits, lantern slides, printing, etc., and renewals.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Boston, Mass., is calling attention to the practicability of using miniature incandescent electric-lighting outfits for Christmas tree decoration. In the issue of "Edison Light" for December there is a pictorial supplement showing interior views of the exhibition department of the company, at 1 and 2 Head place, Boston, Mass.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, is calling attention to its new catalogue descriptive of material from its miniature department. Special contracts are made for lamps in large quantities to be used during a year's time. The company carries a large and complete stock of material for decorative purposes in its miniature lamp department.

THE PHELPS COMPANY, Detroit, Mich., will be pleased to send its miniature catalogue on "Hylo" electric lamps to any one interested, upon request. This catalogue illustrates and describes the turn-bulb "Hylo," the pull-string "Hylo," the long-distance "Hylo," the three-step "Hylo," the double-eight "Hylo," the photo "Hylo" and the annex "Lyho" and the pull-string "Lyho." These lamps employ the double filament, which is a feature with the Phelps Company's apparatus.

THE EMPIRE STATE DRY BATTERY COMPANY, 80 Fulton street, New York city, has equipped its new factory with the latest and most modern machinery for the manufacture of dry batteries. This factory is located in the heart of the business section of New York city, and is possessed of every desirable feature for first-class production. Mr. John Smith, formerly superintendent of the Electric Contact Company's factory, New York city, has accepted a position as general manager with the new company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that seven of its railway generators, driven by a variety of prime movers, are to be seen in the Intramural Electric Railway power-plant, Machinery Hall, St. Louis, Mo. These will be ready for immediate delivery on January 1. The Crocker-Wheeler Company's bulletin No. 470 describes the intramural plant and contains a fine map in colors of the exposition grounds. The company will be pleased to mail this bulletin to any one interested upon request.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 Market street, St. Louis, Mo., is calling attention to the Commercial incandescent lamp in a unique fashion. The company is distributing a mailing card bearing the inscription: "It only costs one cent to find out the merits of the high-grade Commercial incandescent lamp." Instead of the characters, "one cent," being printed, however, a genuine coin is inserted in the card. It is assumed that this coin will pay for the postage of an enquiry to the Commercial Electrical Supply Company.

THE NEW YORK COIL COMPANY, 52-54 Park Place, New York city, is calling attention to its "Fire Ball" jump-spark coil, with or without vibrator. This coil is claimed to be absolutely waterproof, and guaranteed to give a perfect spark. The No. 1 coil consumes three-quarters of an ampere at six volts pressure. The No. 2 coil consumes one and one-half amperes at six volts. This gives a heavier spark than the No. 1 coil, and will give satisfaction with a pressure of four volts or over. The size of the coil is six and one-half by two and three-quarters by two and three-quarters inches, with a half-inch extension at the base. These coils are put up in oak cases, and the cases are filled with waterproof compound.

THE BROWN CORLISS ENGINE COMPANY, Corliss, Wis., has secured from the city of Milwaukee, Wis., a contract to furnish and erect complete at the North Point pumping station one twenty-million-gallon, triple-expansion, high-duty, crank and flywheel pumping engine, according to plans and specifications prepared by the city of Milwaukee, and according to plans and specifications submitted by the Brown Corliss Engine Company. The total amount of the contract is $64,500. The contract was awarded after a thorough inspection of the company's plant by the city engineer and the board of public works. The company is now at work extending its foundry sixty feet in order to take care of the large amount of work on hand and in prospect.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is distributing an illustrated catalogue descriptive of electrical novelties. A very complete line of miniature electrical railway apparatus is presented. These novelties are substantially constructed and are made with all parts interchangeable. In addition to the listing of electrical toys are private-line battery call telephones, electric heating and cooking apparatus, medical batteries, electrical decorative lighting outfits, and flash lamps. The Ewing-Merkle company has filled seven floors of one of the largest houses in the West with electrical supplies of every description. A "Green Book" of general supplies, and special bulletins on dynamos, motors, arc lamps, incandescent lamps, fans, watchmen's registers, lighting supplies may be secured from the company on request.

THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ontario, has sold to the Hamilton Cataract, Power, Light and Traction Company, for use in its Victoria substation at Hamilton, Ontario, two motor-generator sets, each consisting of a synchronous motor and a direct-current generator. The motor-generator sets will be of the two-bearing type, the generators delivering direct current at 550 volts to the railway system, and each being rated at 750 kilowatts. The synchronous motors will take two-phase current at 8,000 alternations and 2,400 volts, and will be rated at 1,380 horse-power. The excess of capacity in the motors is provided so that they may be used for raising the power-factor of the transmission system. Power is taken through lowering transformers from the high-tension transmission lines from the De Cew Falls station of the company. These motor-generator sets will be built at the works of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is building a three-story addition to its factory which will add 50,000 square feet of floor space to the plant. The construction is of the slow-burning type, and it is expected that the addition will be ready for occupancy about the first of the year. The cost will be about $50,000. The building will be equipped with the Grenelle system of sprinklers, will be heated by the Paul system and lighted with mercury vapor lamps. The fire storage tank, with a capacity of 75,000 gallons, will be located under the boiler room, and the fire pump will have a capacity of 750 gallons a minute. The power plant for the entire factory will be in the new building and will be up to date in every respect. As soon as this building is completed work will be begun on an addition to the present office building, to which another story will be added. The third floor of this building will be entirely devoted to the engineering department, while the superintendent, chief of the engineering department, cost department, publicity department and a part of the accounting department will occupy the second floor. The executive offices and the rest of the accounting department will be on the first floor as at present. The works of the Cutler-Hammer Manufacturing Company now occupy an entire block with the exception of a small plot on one corner. Recently this company purchased a plot of ground on St. Paul avenue, opposite its factory, upon part of which a brass foundry has been erected. Upon the remainder of this property buildings will be erected the coming year for storage and factory purposes.